THE YEAR BOOK *of*
GENERAL SURGERY

(1959-1960 YEAR BOOK *Series*)

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ANESTHESIA

INTRODUCTION

During the past year there has been continued lively i
est in many areas of surgery with increasing intensit
research activities along both clinical and experimental
of endeavor While this general trend of increasing act
has been maintained, it is readily apparent that a hi
degree of interest exists in some areas than in others M
over, even in these fields of more intense activity some s
in emphasis may be observed As indicated in the last
Book, such shifting interest and emphasis characteriz
progressive movements in medicine

This is well reflected by the field of cardiovascular
gery, in which there has been an increasing intensity c
vestigation, providing many notable advances over the
decade The artificial heart-lung apparatus is now l
widely used for an increasing number of congenital an
quired cardiac lesions with results that are steadily im
ing More clinical experience has provided further imp
ments and refinements in the technical procedures T
has been some shift in emphasis away from cardioplegic
cedures, except for special purposes, and toward the
bined use of hypothermia with the artificial heart-lung a
ratus Further studies are being directed toward some c
problems concerned with the various types of oxygen
in an effort to elucidate some of the physiologic altera
associated with "open heart" surgery

Continued high interest has also been maintained i
surgical approach to acquired disease of the aorta and n
arteries Here again sufficient experience has been acc
lated to provide better evaluation of various surgical r
ods and to establish certain concepts Synthetic vas
replacements as substitutes for homografts have nov
come widely accepted The concept that atheroscleroti
clusive disease may be well localized and segmental in
acter, may involve major arteries other than those supp
the lower extremities (such as those of the gastrointes
tract, the kidneys and the brain) and may be treated suc

mented Accordingly, increasing interest has been devoted toward application of these surgical methods designed to restore normal circulation in a wide variety of disorders resulting from occlusive disease of these major arteries Long-term results are beginning to be reported, and while some of these reflect a note of discouragement, this is contrary to our own experience

Increasing interest may be noted in the use of venous shunting procedures for the treatment of cirrhosis of the liver Information is gradually accumulating to aid in defining the true value of portacaval shunt in the management of bleeding esophageal varices, and there has been a revival of interest in the use of this procedure for the treatment of ascites There is need, however, for more experience and investigation in regard to the latter condition before this issue is finally settled

Steady progress is also being made in the field of homotransplantation of living tissue At present, there are a number of experimental technics by which animals may be made tolerant to the transplantation of skin or organs Some of these, including the injection of splenic cells into newborn animals, are discussed in this volume A few years ago it appeared that these might be applicable to the human patient, but the technics that enhance the acceptance of transplants have, in many instances, a deleterious effect on the host so that maldevelopment or even death may result As a consequence of these untoward reactions, human studies have been limited Thus the most practical application of transplantation today remains the transplanting of skin or organs between identical twins An evaluation of this procedure is included in the report by Joseph Murray and his associates on renal homotransplantation (p 20)

Despite the dangers of transplantation of splenic or marrow cells some clinical studies are being carried out In France for example, several scientists who were exposed to potentially lethal doses of irradiation were treated with homotransplantation of bone marrow The transplanted cells survived for only a few weeks, but it is possible that homotransplants served to sustain the patients until their own marrow systems could regenerate Also in some patients with advanced malignant disease large doses of total body

irradiation are being administered, followed by marrow transfusions, in heroic attempts to control an otherwise fatal disease. As a corollary, technics developed to prepare and preserve marrow are being used to store autologous bone marrow before treatment with drugs or irradiation in doses large enough to depress the patient's bone marrow. Following treatment, the marrow may be repopulated with the patient's own cells with the use of marrow infusions, thus allowing the use of larger doses of antitumor agents than could be used safely in the past. Significant advances in this fascinating field will be documented in future issues of the YEAR BOOK.

Once again I should like to thank Mr. William A. Keville, Managing Editor, for his assistance and unlimited patience during the preparation of this volume. I should also like to extend my grateful appreciation to Dr. George L. Jordan, Jr., Associate Professor of Surgery at Baylor University College of Medicine, and to Miss Sara Meredith, Editorial Assistant, for their untiring and thoughtful help.

MICHAEL E. DE BAKEY

GENERAL CONSIDERATIONS

Hypnosis in General Surgery is evaluated by Elmer Hoffman[1] (Johns Hopkins Univ) Hypnosis can play an important role in averting or converting a patient's preoperative apprehension and anxiety Preoperative hypnosis can give many patients comfortable rest on the preoperative night Hypnosis can relieve the discomfort and enable the patient to meet his difficulties in a better frame of mind By adding posthypnotic suggestions the surgeon can prolong the action of his suggestions

Examination of an acute abdomen, especially with respect to the pelvic and rectal portions, can be performed more easily in hypnoidal or light-trance states Hypnosis has been used as an anesthetic agent for a long time Hypnoanesthesia is not true anesthesia, but is analgesia It should not take the place of the technics and agents of modern anesthesiology Hypnoanesthesia can be produced in 1 of every 4 patients on the first trial With further training of the patient, this percentage of success can be increased Hypnoanesthesia is indicated in patients sensitive to local anesthetic agents Regardless of the area of the body being operated on this method is effective to the same degree

Position maintenance during many surgical procedures and examinations can be more uncomfortable or painful to the patient than the procedure itself This may be true in any of the endoscopies Hypnosis or relaxation helps the surgeon and the patient Operations within the mouth, or the buccal mucosa, pharynx or tongue which require a painful constant position by the patient can be made easy with the aid of hypnosis If desired, the entire operation can be carried out under suggestion and relaxation without any anesthetic

Use of hypnosis can aid or prevent many painful or distressing postoperative situations These situations include pain that is increased by apprehension delay in ambulation because of fear of pain or fear of disability stimulation of cough postoperatively especially in abdominal and thoracic

(1) Am Surgeon 25 163 169 March 1959

surgery; elimination of fear and pain in rectal surgery; elimination of urinary retention secondary to spasm and fear of exerting intra-abdominal pressure; multiple painful dressings, as in burn cases, infected wounds and removal of packs or drains; and elimination of self-made fears, such as those concerning removal of stitches or adhesive tape.

Surgical Aspects of Fibrinolysis. According to J. Fenimore Cooper[2] (Kaiser Found. Hosp., Los Angeles), serum proteolytic activity probably is essentially a homeostatic mechanism concerned with lysis of superfluous fibrin and other humoral debris of protein origin. In the steady state, there is a delicate, precise balance between proteolytic and antiproteolytic factors in the serum. Under normal conditions, the blood manifests no fibrinolytic activity. Under stress, such as trauma and major surgery, considerable serum proteolytic activity may become clinically apparent.

Fundamentally, serum proteolytic activity results from interaction between plasminogen, an enzyme precursor in the blood, and a system of activators of diverse origin. A proteolytic enzyme, plasmin, that is capable of hydrolyzing fibrin, fibrinogen, prothrombin, antiplasmin and other serum proteins is consequently liberated. The degree of activation obtained may depend on the relative concentrations of activator, plasminogen and inhibitor that are present at the site of activation.

The development of plasminemia in surgical states is probably as physiologically homeostatic as the process of coagulation, but less fully understood. Actual induction of serum fibrinolysis in surgical states may be considered a local or general process dependent entirely on the degree of activation of plasminogen initially by liberated tissue activator. In addition, the intrinsic antiproteolytic titer of the individual is of equal importance in localizing and inhibiting exuberant fibrinolytic factors in operation. In most surgical procedures, some fibrinolytic activity can be detected clinically by suitable laboratory technics. Surgical procedures on specific organs, such as the prostate, lung, uterus and pancreas, can at times induce strong fibrinolytic activity because of the unusually high tissue activator present in these organs. Despite variation in the tissue activator pres-

ent, the development of fibrinolytic activity is a well controlled process in most surgical procedures

Regional Heparinization and Heparin Inactivation by Erythrocytes Regional heparinization is administration of heparin into a vessel at a rate that prevents thrombosis in the heparinized vessel and its ramifications without elevating clotting time of blood in the vascular system other than the vessels into which the heparin is injected

Prolonged regional heparinization of a large artery with blood flowing rapidly through it is often attended by general heparinization This happens because inactivation of heparin in the artery takes place more slowly than circulation time of the blood through the extremity Nonetheless, regional heparinization could be assuredly produced by neutralizing the heparin given intra-arterially before it enters the general circulation This effect was produced by Gordon and his associates by infusing heparin into the femoral artery and protamine into the respective femoral vein

David A Ohlwiler and Earle B Mahoney[3] (Washington Univ) tested the feasibility of regional heparinization over 5 hours by using varied infusion rates and found that it can be obtained only transiently even with slow rates of intra-arterial injection, general heparinization ultimately occurs Erythrocytes were capable of inactivating heparin in vitro If they possess this capacity in vivo they may well be an important factor in in vivo inactivation of heparin in addition to the serum enzymatic destruction of heparin Whether this phenomenon is related to destruction of heparin by an *intracellular enzyme the binding of heparin to the red blood* cells or some other action is unknown The clotting time of blood from vessels into which cannulas or needles were placed was remarkably shortened

Surgical Management in Hemophilia and Hemophilioid Diseases is evaluated by Ivan W Brown Jr Wirt W Smith and Ralph M Howse[4] (Duke Univ) The first principle of treatment of hemophilia and hemophilioid states is to restore and maintain the patient s blood clotting mechanism at a satisfactory level before operation and until healing of the wound or injury is sufficient that bleeding will

(3) Surg Gynec & Obst 107 353 358 September 1958
(4) Ann Surg 149 721 736 May 1959

not occur when all forms of treatment are discontinued.

Only 5-10% or less of antihemophilic globulin is required to maintain hemostasis in the uninjured otherwise healthy hemophiliac, yet it may be necessary to raise this level to 10-20% of normal to maintain hemostasis in hemophiliacs with severe injuries or large operative wounds.

The dosage of fresh blood or plasma required for proper hemostatic effect will vary with: (1) the severity of the patient's bleeding tendency or his own level of antihemophilic globulin; (2) the extent of the injury and the rate of blood loss; and (3) presence of tissue necrosis or injection.

The patient's antihemophilic globulin level can be raised about 1% by 1 cc. fresh normal plasma/kg. body weight. However, in hemophilia and in the other hemophilioid conditions, because of the variables involved, it is best to regulate blood and plasma administration according to the response of the partial prothrombin time test. After the test shows a favorable level by significant shortening of the partial prothrombin time of the patient's plasma, the amount and frequency of transfusion can be fairly accurately determined.

Minor wounds and injuries present no problem so long as hemostasis is properly controlled and so long as the patient is not denied, out of fear of the disease, the same treatment that would be given to a nonbleeder with an identical lesion. Treatment of hemophilic hemarthrosis and arthropathy is largely nonsurgical. Traction, physical therapy and corrective plaster casts can do much to minimize or correct the crippling deformities. In dental surgery, hemorrhage can be minimized by preparing beforehand an impression of the operative site, including a sufficiently large intact area on each side. After the extraction, suturing the gum margins should not be attempted because this may result, if arterial bleeding occurs, in a dissecting hematoma. The empty socket may be packed with Gelfoam® moistened with thrombin and dipped in dry thrombin powder. Hemorrhage into the retropharyngeal tissue, the tongue, larynx, fauces or the floor of the mouth can cause swift death by asphyxia. Maintenance of an adequate airway is paramount. Tracheal intubation is probably the method of choice.

Until potent animal or human antihemophilic globulin

concentrate becomes readily available, perhaps only the most desperate cases or patients with the milder form of the disease should be subjected to major abdominal surgery Surgical care of diseases of the genitourinary tract in the hemophiliac presents no special features

Neonatal Asphyxia Pallida Treated with Hypothermia Alone or with Hypothermia and Transfusion of Oxygenated Blood was investigated by Bjorn Westin, James A Miller, Jr Rune Nyberg and Erik Wedenberg[5] Six babies with asphyxia pallida were cooled in running water at temperatures between 8 and 14 C Total time in the water varied between 4 and 39 minutes Minimum colonic temperatures were 23 30 4 C In 3 babies, regular breathing began spontaneously without further treatment 14 23 minutes after birth and at body temperatures of 27-34 C The other 3 infants were given 75-150 ml oxygenated blood when it appeared that cooling alone might not be adequate These began breathing at 18 79 minutes after birth and at temperatures between 32 and 23 C Hearing tests performed between 12½ hours and 22 days demonstrated no loss of acuity between 500 and 4,000 cycles per second This is in sharp contrast to records previously obtained from babies that had recovered from severe asphyxia with or without neurologic symptoms Of the 6 infants, 1 died at 30½ hours apparently from aspiration of vomitus, 5 are alive, growing and apparently normal

Hypothermia has been a lifesaving measure in experimentally asphyxiated newborn animals It played the same role in these human newborns Recovery is possible from apneic periods of over 1 hour when hypothermia is combined with injections of oxygenated heparinized blood These 6 patients with asphyxia neonatorum treated with hypothermia bring the human infant into line with other newborn mammals in which cooling has been demonstrated to be a lifesaving procedure The original rationale for its use is van't Hoff s law which states that the rates of chemical reactions vary with the temperature Thus by reducing the rate of consumption of energy stores it was postulated that drastic cooling would greatly prolong asphyxial survival

(5) Surgery 45 868 879 May 1959

Earlier methods, involving the alternate use of cold and hot water were based on the belief that respiration can be initiated by shocking the nervous system by sudden changes in temperature. This may be effective in slightly or mildly asphyxiated infants. However, by the time muscle tonus is lost, central nervous system depression is so great that the infant is incapable of responding to any stimulus. The same situation explains the ineffectiveness of pharmacologic respiratory stimulants in severe asphyxia.

A secondary effect of hypothermia is generalized vasoconstriction. In asphyxia pallida, the baby is in a shocklike state with generalized vasodilatation that results in pooling of the blood and totally inadequate circulating blood volume. The early appearance of normal breathing in the first 3 patients suggests that some sudden response to the cold water may have taken place. The intrinsic muscles of the blood vessels may react to cold even in absence of nervous stimulation.

► [Despite the steady decline in infant mortality during the past 50 years, no significant change has occurred in the neonatal death rate. One of the most important causes of death in the newborn is asphyxia. Recent studies by Dr. Murdina Desmond of our Department of Pediatrics and Dr. W. S. Henly of our Department of Surgery have demonstrated that these infants respond favorably to minute increases in blood oxygen content. As most of these infants are already hypotensive and hypothermic, most effective support can be obtained by the addition of oxygenated blood to the patient. Drs. Desmond and Henly have prepared a miniature heart-lung machine or "artificial placenta" to be used in cases of respiratory distress. Venous blood is withdrawn from the infant, pumped through a small plastic chamber which adds oxygen to the blood and returned saturated with oxygen to the infant's circulation.

This method gives promise of an important development in the treatment of these neonatal disturbances.—Ed.]

Re-evaluation of Pretreatment Given to Adult Animals to Modify Their Responsiveness to Skin Homografts is made by André Castermans[6] (Univ. of Liége). When injected into the embryo or the newborn, spleen cells of the blood buffy coat layer permit prolonged survival of a subsequent skin homograft of the same genetic origin. The treated animals undergo general aplasia, become runts and die in some cases. Lymphatic tissue is especially involved in this reactive process stimulated by the foreign cells. The injected cells must be immunologically active, and the "runt

(6) Transplant Bull. 5:381-387, October, 1958.

disease" seems to be caused by production of antibodies against the host

The effects of living spleen cells injected into a mature mouse of an unrelated strain are closely dependent on dosage Low dosage has no significant effect on biologic responses Medium dosage, though producing no obvious pathologic effects, causes a significant number of deaths, but death is the rule after injection of large amounts of spleen cells In the last instance significant signs of involution of the lymphatic tissues as a whole are seen The harmful effects of these cells must be related to their immunologic competence The minimum dosage necessary to elicit temporary tolerance and the dosage needed to induce involution of the lymphatic tissues are more or less identical, therefore, it might be assumed that the first phenomenon is not a consequence of the second

Support for this hypothesis is offered by the lack of isohemagglutinins in the blood of animals treated with high dosages The mechanism of the prolonged survival of the grafts thus seems to differ from that of the enhancement described by Kaliss and co-workers Indeed, isohemagglutinins are constantly observed when enhancement is elicited by tissue extracts Further, the factor insuring homograft survival is production of isoantibodies in treated mice

Most probably the effects the author observed depend on the severe attack on the lymphatic tissues of the host by the foreign cells The negative results of pretreatment with desoxyribonucleic acid apparently reinforce this conclusion and seem consistent with unsuccessful attempts made by Kaliss to influence the fate of normal skin homografts with tissue extracts Billingham and co workers have succeeded however, in slightly enhancing the survival of skin homografts by suspensions of lyophilized tissues It is assumed that enhancement is secured by substances originating from the cytoplasm

The danger of injecting living spleen cells or blood leukocytes even into adult, immunologically mature animals is stressed This is probably true also for human beings whose tolerance for homotransplantation might be temporarily enhanced by such procedures Cognate phenomena occur in mice irradiated with lethal doses of x-rays and saved by

the injection of normal bone marrow The protection conferred by homologous cells is much inferior to that obtained by isologous material

► [There is evidence to suggest that runt disease which follows injection of splenic cells into newborn animals represents a graft against host immunologic reaction with the graft ultimately destroying the host and is thus similar to the homologous disease observed in animals treated with homologous bone marrow transfusions following total body irradiation These observations have resulted in limitation of investigation of induced tolerance in the human —Ed]

Fate of Human Fetal Homo- and Heterografts Hamilton Baxter, Marcy A Goldstein and Gardner C McMillan[7] (McGill Univ) report experiments in which skin from 17 fetuses varying from 17 to 33 weeks' gestation was grafted on fresh beds of human recipients aged 1 64 All the grafts took initially, but none survived over 46 days Two grafts from fetuses of 12½ and 16 weeks' gestation survived 16 and 20 days respectively Biopsies of fetal and recipient skin revealed a typical homograft reaction with dense infiltration of mononuclear cells, predominantly lymphocytes and plasma cells

Blood groups of fetuses were not identical with those of recipients Statistical analysis revealed no significant correlation between survival time of the skin graft and age of the fetus or recipient There was no correlation between survival of the graft and sex of the donor and recipient Skin of identical twins applied to the same recipient sloughed simultaneously Thin slices of various human fetal tissues of 6 16 weeks' gestation, including skin, muscle, cartilage, bone and various organs, were implanted subcutaneously in human beings aged 8-47 Cartilage and bone survived longer than any other tissues implanted One graft showed viable cartilage and bone at 250 days, whereas skin did not survive longer than 41 days

Heteroimplants of human fetal tissues aged 7½-13 weeks inserted subcutaneously into adult rabbits survived for 29 days Tissues from the same fetuses implanted into adult rats persisted for 41 days None of the recipients of these grafts was conditioned by methods known to prolong tolerance of homologous tissues

Under the conditions of this experiment, it appears that

(7) Plast & Reconstruct Surg 22 516 524 December 1958

fetal tissues of 6-33 weeks' gestation provoke a typical homograft reaction Duration of survival of a fetal graft or organ may vary with age, viability and type of tissue used With regard to the recipient, duration of survival of a fetal graft or organ possibly may vary with age, site of implant, gradual or immediate establishment of vascular connections, general and immunologic health of the host and genetic relationship

Prolonged Survival of Fetal and Adult Skin Homografts was studied by Reuven K Snyderman[8] (Sloan Kettering Inst) Of 17 patients with neoplastic diseases who received skin homografts, 11 had successful takes Of these 11 patients, 6 (54%) had prolonged survival of the homograft Laboratory studies carried out on these patients failed to reveal any significant differences between those who had long term survivals and those who did not

Fifteen fetal skin homografts were applied These grafts had been taken from fetuses of one-half their gestation period or less Six of these grafts were successful and 3 (50%) had prolonged survival time The fetal skin slowly matured and showed hair growth by the 7th month

The patient with malignant disease is unable to build up resistance to the homograft and therefore accepts it This fact is useful clinically in a number of ways The patient *with neoplastic disease in need of skin grafts could be* spared the added trauma of using his own skin for grafting Skin could be used from a tissue bank

A few patients with leukemia have been given bone marrow injections in an attempt to improve their condition As a preliminary, skin homografts were carried out It is postulated that the patient who retains a skin homograft is more likely to hold a bone marrow transplant

Consideration is also being given to use of the skin graft as a therapeutic test Patients with neoplastic diseases could have a skin homograft applied before treatment is started If the graft is successful before treatment, it can be carefully observed after treatment If the disease is controlled *perhaps the graft would be rejected If not perhaps a second homograft would not survive* It would be of great value to the physician treating the patient to be able to watch the

(8) *S Clin North America 39 501 507 Apr l 1959*

homograft as an indication of the state of the patient's disease

► [The hypothesis that acceptance or rejection of a skin homograft might indicate the status of a patient's malignancy is intriguing, but of more significance will be efforts to determine the mechanism by which certain malignancies impair the homograft rejection mechanism —Ed]

Anergy and Skin Homograft Survival in Hodgkin's Disease Skin tests for delayed bacterial sensitivity were carried out by William D Kelly, Robert A Good and Richard L Varco[9] (Univ of Minnesota) in 28 patients with Hodgkin's disease and 208 patients with various other diseases Microbial antigens used were diphtheria toxoid, streptokinase streptodornase, mumps virus, mumps control solution, Trichophyton gypseum, Candida albicans and purified protein derivative, intermediate strength Patients with Hodgkin's disease showed delayed allergic skin reactions (at 24 and 48 hours) much less often than control patients Of the patients with Hodgkin's disease, 64% were completely anergic, having no reactions to any of the antigens, but only 1% of the controls were nonreactors

Skin homografts were performed in 13 patients with Hodgkin's disease Initially, all took completely or nearly so Two grafts subsequently behaved as if they were autografts with only slight desquamation during early healing and later slight to moderate contraction with passage of time One graft was observed until the patient died 7½ months after placement The second graft remains intact 13 months after operation In 8 instances grafts showed prolonged survival and abnormal rejection pattern, characterized by apparent early healing followed by subsequent late reaction, which resulted in gradual loss of part or all of the homograft This late reaction commonly appeared 5-12 weeks after placement, with formation of red crusts that remained in place several weeks then scaled off There was little or no erythema of surrounding host skin When the crusts came off, the underlying area was covered with intact epithelium with identifiable ink dots still present in the same pattern as that of their original placement After several months of such reaction, remaining graft tissue survived without further acute reaction In 6 of these 8 patients there have been persistent areas of tattooed skin dur-

(9) Surg Gynec & Obst 107 565 570 November 1958

ing follow-up of 2½-11 months, whereas in 2 children late reaction resulted in apparent complete loss of the graft In 3 patients (2 adults and 1 child), typical homograft rejection occurred 2-3 weeks after grafting with sudden necrosis of the entire graft

It seems likely from these studies and from those on prolonged survival of skin and lymph node homografts in agammaglobulinemic patients that the homograft reaction may be a complex type of immunity in which antibody and specific allergic cellular mechanisms play a role

Kidney Transplantation between Seven Pairs of Identical Twins is reported by Joseph E Murray, John P Merrill and J Hartwell Harrison[1] (Boston) Total experience at the Peter Bent Brigham Hospital consists of 24 patients with kidney transplants Of these, 16 were from unrelated donors—none survived permanently although 1 lived for 5½ months and 4 others had measurable function

Of 16 twins observed 8 had transplants and 7 had return of normal function clinically, chemically and by x ray One of these patients died 4 months after transplantation when the transplanted kidney became involved with the original disease One other, still living had signs and symptoms suggestive of active disease in the transplant

Four others were living and well, the longest 3½ years after transplantation One recipient successfully completed a normal pregnancy 1½ years after transplantation

The last ill twin a man aged 24, with acute exacerbation of chronic glomerulonephritis had a left nephrectomy Four days later, a renal homotransplant from the well twin and a simultaneous right nephrectomy were performed This plan minimizes the possibility of the original disease developing in the transplant In 3 weeks this patient became normal clinically, chemically and by x ray

TECHNIC —Two simultaneous operations—the nephrectomy and *the transplantation—are started in 2 adjacent operating rooms* The nephrectomy on the healthy donor requires careful dissection of the vasculature to obtain maximum length of the renal artery and vein Continuous spinal anesthesia is used The recipient site is prepared in the right lower quadrant retroperitoneally exposing the iliac vessels from the bifurcation of the aorta to the inguinal ligament All terminal branches of the hypogastric artery are dissected with care to preserve each branch for possible use if renal anomalies are

(1) Ann Surg 148 343 359 September 1958

noted in the donor The retroperitoneal area is dissected widely in a lateral direction to allow room for the kidney.

The renal artery is anastomosed end to end to the hypogastric and the renal vein end to side to the external iliac vein If 2 or 3 renal arteries are present, suitable branches of the hypogastric are selected The ureter is passed through a muscular tunnel and sutured to the bladder mucosa Urine flow usually starts immediately, and by the conclusion of the operation copious diuresis is in progress

The kidney rests a bit uncomfortably in the concavity of the ilium, with some tendency to be pushed forward However, it is protected in its new position under the abdominal musculature and fascia and does not require fixation sutures, the contents of the peritoneal cavity being sufficient to keep it immobilized

The time lapse from clamping of the blood supply in the donor to its restoration in the recipient has been 55 and 75 minutes A ureteral catheter to the renal pelvis of the transplant, although not essential, was used on the first 3 occasions

The natural site for the homograft, the renal fossa, has two disadvantages. First, it requires simultaneous nephrectomy, thus increasing the magnitude of the operation Second, it necessitates ureteroureteral anastomosis, with possibility of subsequent stricture formation because the length of the transplanted ureter vascularized by the renal pedicle is too short to reach the bladder The iliac fossa as the recipient site has proved adaptable to man The iliac vessels are of appropriate caliber, and the short ureteral segment may be implanted directly into the bladder. The donor kidney fits only into the opposite iliac area, i e , left kidney to right iliac fossa or vice versa This produces a proper anteroposterior relation of the arteries and veins and directs the ureter to the bladder without twisting

The ureter being led obliquely through an incision in the inferior and lateral aspect of the vesical muscle does not show evidence of reflux In 1 patient, peristalsis was observed grossly in the completely denervated ureter at the time of transplantation and by excretory urography several months later

The most striking finding postoperatively is rapid restitution of well-being and appetite Convulsions cease and congestive heart failure and azotemia disappear The appetite becomes voracious and caloric intake is excessive to make up for the months of debilitation There is an immediate output of a large volume of dilute urine Renal function then progresses rapidly toward normal within 4 months

Renal plasma flow and filtration rates increase by about 35% within a week and then progress more slowly to about 75% of the value of two kidneys In patients with severe hypertension, blood pressure drops almost but not quite to normal with transplantation of a third normally functioning kidney It returned exactly to normal when the two bad kidneys were removed

► [These observations are extremely interesting The fact that trans plants of tissue between identical twins can be accomplished successfully has been known for several years These investigators have taken the initiative in putting this knowledge into practical application with renal transplants The success and significance of their observations cannot be overemphasized One of the interesting problems has been the develop ment of disease in the transplanted kidney Although this unfortunate circumstance is distressing, considerable information concerning the basic disease process may be obtained through such studies —Ed]

Evaluation of Endocrine Transplants According to Joseph E Murray[2] (Peter Bent Brigham Hosp), despite increasing reports of successful human homografts of endocrine tissues, evidence of function is not completely convincing Ideal experimental criteria might be (1) presence of an absolute deficiency state, (2) correction of deficiency after grafting, (3) microscopic evidence of graft survival and (4) return of deficiency state by removal of the graft Further, the presence or absence of ectopic or regenerated endocrine tissue should be verified by postmortem study All these criteria cannot be met in human beings Chief clinical difficulties are variability of the disease state and undesir ability of obtaining biopsy material from a potentially functioning graft Because symptoms may vary in deficiency diseases, clinical improvement after insertion of a graft is not conclusive evidence of graft survival and function After a graft for ovarian deficiency, changes in vaginal cornification might conceivably be mediated through the adrenal as a result of fluctuations in release of trophic hormones from the pituitary In hypoparathyroidism an adaptation to the deficiency state may occur In dogs from which all para thyroid tissue is removed at one operation severe tetany consistently develops whereas in gradual removal of all parathyroid tissue in multiple operations there are mild symptoms or no symptoms, except in times of stress

In the framework of these necessary limitations reported

(2) *Transplant Bull* 5 369 370 October 1958

instances of endocrine survival must be questioned when any supplemental medications, no matter how sporadic or small, are required One of the author's patients with a vascularized thyroparathyroid transplant had dramatic relief and a 10 fold decrease in supplemental medication immediately after operation After 2 years there has been no need for supplemental calcium, and the thyroid has begun to take up radioactive iodine However, until microscopic evidence of surviving tissue is available, this instance must also be questioned

That blood supply is important to function is suggested by the development of transient symptoms of hypoparathyroidism after thyroidectomy, apparently due to disturbed blood supply. Hence it is difficult to imagine implants of auto- or homografts ever assuming significant function Neonatal donor tissue of low antigenic quality may grow and require years to develop function The methods are promising, but some doubt will exist until microscopic evidence is obtained or complete and permanent restoration of function under all circumstances ultimately occurs

Emergency Surgery in the Elderly Patient was studied by Herman A Jacobson and Peter Beaconsfield[3] Of 1,267 patients over age 65 admitted to the general surgical wards at Cook County Hospital during 1954 and 1955, 169 required emergency operation The conditions necessitating emergency surgery fell into four categories acute abdominal disorders, strangulated hernias, gastrointestinal bleeding and acute urinary retention The causes of 81 acute abdominal conditions were intestinal obstruction resulting from neoplasm, adhesions, volvulus of the gut and regional ileitis Other underlying disorders included acute appendicitis, perforated peptic ulcer, acute cholecystitis and diverticulitis Of 54 strangulated hernias, 15 required bowel resection History of heart attacks was noted in 17 patients and abnormal ECG findings in 30 None of these patients had difficulties during surgery or postoperatively

General anesthesia was used in 67 patients, local in 73 and spinal in 29 All surgical procedures, except bowel or gastric resections, were performed in less than 1 hour Mortality was 8.8%, as compared with 4.9% for elective proce-

(3) J Am Geriatrics Soc 6 657 666 September 1958

dures The 15 postoperative deaths were due to cardiovascular complications in 6, overhydration and pneumonia in 3 each, carcinomatosis in 2 and pulmonary embolus in 1

Good results in emergency geriatric surgery depend on prompt decision to operate, rapid and brief preoperative preparation, restriction of surgery to removal of immediate cause of illness and careful postoperative care, with particular emphasis on conservative fluid intake, breathing exercises, early ambulation and encouragement of self reliance

Surgery Complicated by Pregnancy. R H Walker and E M Greaney[4] (North Hollywood, Calif) *report that during* 5 years 104 of 65,038 women delivered at two large hospitals required major surgery during pregnancy Surgery was performed on 49 patients with diagnosis of acute *appendicitis, but in 14 laparotomy failed to disclose the cause* of symptoms Most perforated appendixes occurred in the last trimester There was no maternal mortality, but 4 fetal deaths (8%) occurred In 3 patients with acute perforated appendixes, a well-walled off abscess was noted, *the uterus* formed one of the abscess walls, and 1 abscess had eroded from the cecum into the uterine cavity Duration of symptoms was 14, 10 and 3 days Diagnosis of acute appendicitis *is often missed during pregnancy because of lack of clinical* suspicion and difficulty in evaluating abdominal pain

Nearly all ovarian cysts were diagnosed during the last trimester A twisted pedicle or torsion of an entire ovary *and tube occurred rather frequently and at times was* erroneously diagnosed as acute appendicitis Generally cysts that measure 6 cm or more and are persistent painful or enlarging should be investigated Many with impaired blood supply, but not gangrenous can be resected, with repair of the ovary and fixation to prevent torsion

Four dermoid ovarian tumors and 1 dysgerminoma were noted Only 2 patients showed intestinal obstruction Six ventral and 1 femoral hernias were operated on Two operations were elective Five hernias were incarcerated In 1 patient, gangrenous bowel was resected Surgery for breast carcinoma was done in 2 patients, and 3 were treated for acute gallbladder disease

Sometimes situations arise that mak[illegible]te surgery

(4) West J Surg 66 294 299 Sept Oct 1958

possible only after cesarean section has reduced uterine volume If cesarean hysterectomy is indicated and the condition of the patient warrants, total hysterectomy is still in order.

Postoperative Myocardial Infarction: Report of 35 Cases, seen in a series of 21,000 operations, is presented by Giorgio Feruglio, Samuel Bellet and Hrant Stone[5] (Univ. of Pennsylvania). Although this complication was observed more often during major operative procedures, it was also seen during minor operations. Most important of the predisposing factors was arteriosclerotic heart disease, coronary arteriosclerosis occurring particularly in the older age group. The most important precipitating factor was development of a hypotensive state, particularly if accompanied by shock.

Possibility of myocardial infarction should be considered in the postoperative period, particularly in older patients with preceding heart damage following a hypotensive episode. Pain, fever, leukocytosis and abnormal serum transaminase levels are usually not of great help in establishing diagnosis because of the underlying clinical state of the patient and the multiple causes of these manifestations. The ECG findings may confirm diagnosis.

In older patients and with pre-existing coronary artery or other thromboembolic disease, unless specific contraindication exists, prophylactic anticoagulants administered from the 3d to the 10th postoperative day may be of help in avoiding thromboembolic phenomena.

Mortality was 31.4%. Prognosis in the individual patient depends on many factors: pre-existing degree of coronary artery damage, extent of infarcted area and presence of complicating visceral diseases. In the older age group, prognosis in rather extensive infarcts is poor.

Myocardial and Cerebral Infarctions as Postoperative Complications were studied by Keith D. J. Vowles and John M. Howard[6] (Emory Univ.). Review of 30 patients who had cardiac or cerebral infarction during the 30 days following operation or accidental trauma suggested a biologic difference between these two processes. Of the cardiac infarctions, 63% occurred during operation or within the

(5) A.M.A. Arch. Int. Med. 102:345-353, September, 1958
(6) Brit. M. J. 1:1096-1099, May 10, 1958

first 3 days after operation or injury. All but 23% occurred within the 1st week. The cerebrovascular accidents, however, occurred without apparent time predilection.

A period of hypotension was known to be associated with operation in 53% of the patients. Hypotension results in reduced coronary flow. In the arteriosclerotic patient, whose coronary arteries are unable to dilate appreciably, the reduction in flow following hypotension is probably a major factor in the progression of ischemia.

The complications could not be related to the anesthetic agents used; indeed, 8 followed local analgesia. The increased oxygen requirements of the burdened heart, associated with the decreased coronary flow of hypotension, predispose it to an immediate oxygen deficiency. General anesthesia reduces the oxygen demands of the brain, so that an absolute oxygen deficit is as likely to be postoperative as operative.

Application and extension of the recognized principles of avoidance of anoxia, hypotension and increased cardiac work in arteriosclerotic patients should prevent many myocardial infarctions. The biologic and clinical factors underlying cerebrovascular accidents differ in not being specifically related to the period of trauma. Attempted prevention necessitates empiric application of such measures as adequate oxygenation, inhalation of carbon dioxide and avoidance of undue sedation in arteriosclerotic patients.

► [It has now been well established that cerebrovascular insufficiency may be due to segmental atherosclerotic occlusive lesions involving the extracranial portions of the carotid or vertebral arteries in a high proportion of patients (approximately 25-40%). Our experience would suggest that such lesions may also account for the development of postoperative cerebrovascular "accidents" Under these circumstances, immediate operative intervention with removal of the occlusive process by endarterectomy and thrombectomy provides dramatic and highly gratifying results. More important, however, is the fact that such complications are preventable in patients with these extracranial lesions. Patients, for example, with manifestations of cerebrovascular insufficiency and with findings suggestive of carotid occlusive disease, such as the presence of a systolic murmur over the carotid bifurcation, should have angiographic studies. If such studies demonstrate the presence of segmental occlusive lesions in the extracranial portions of the carotid or vertebral arteries, surgical treatment directed toward restoration of normal circulation through these vessels should be done before the other operative procedure for which the patient was originally admitted to the hospital.—Ed.]

Effect of Operation on Serum Transaminase Levels was

studied by Douglas A Person and Richard D Judge[7] (Univ of Michigan) In 54 patients, who had various types of operations, 246 determinations were carried out in an effort to assess validity of the serum glutamic oxalacetic transaminase determination with respect to myocardial infarction in surgical patients Early in the postoperative period statistically significant rise occurs in the serum glutamic oxalacetic transaminase The mean peak occurs on the 2d postoperative day Fall to preoperative value occurs by the 7th day Statistically, there is less than 1 chance in 1,000 that uncomplicated operation will produce serum glutamic oxalacetic transaminase values within the range that is diagnostic of acute myocardial infarction

Exceptions in which abnormal elevations might occur include (1) biopsy or manipulation of the liver, (2) biliary tract surgery, (3) extensive trauma to skeletal muscle, (4) large postoperative abscess or hematoma with cellular necrosis and hemolysis, (5) thoracotomy with pulmonary resection and (6) possibly prolonged anesthesia If these exceptions are kept in mind, the serum glutamic oxalacetic transaminase determination should be helpful in evaluating acute myocardial infarction during the postoperative period The fact that statistically operation alone is unlikely to raise the serum transaminase above 60 units must be balanced in each patient against duration of the anesthesia, amount of trauma and type of procedure

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SHOCK, FLUIDS AND ELECTROLYTES

Shock and Blood Pressure are evaluated by F A Simeone[8] (Western Reserve Univ) Shock has many etiologic factors related only in that they have the same physiologic results, viz , hypotension and poor perfusion of at least some tissues and organs In some conditions in which there is inhibition, depression or block of vasoconstrictor activity, as in extensive sympathectomy, high spinal anesthesia or severe infections, adequate justification can be found for restoring the peripheral vascular resistance to normal by use of

(7) A M A Arch Surg 77 892-897 December 1958
(8) Surg Gynec & Obst 108 740-742 June 1959

vasoconstrictors Even here, however, vasodilatation is not generalized

The circulation conducts its affairs at the capillary, at which level solutes, gases, crystalloids and colloids shuttle from one side to the other of the endothelial membrane that separates the blood from the tissue fluids The blood pressure is only a means to this end Little, if anything, is achieved for a tissue or organ by restoring the blood pressure in the large arteries if this is done at the expense of the capillaries by constricting the arterioles that control their blood supply The action of the agent merely adds to the deprivation of those capillaries and the adjacent tissues

Different vascular beds throughout the body react differently to nervous and humoral stimuli l Norephinephrine causes vigorous vasoconstriction in the skin, but in the myo cardial blood vessels causes extraordinary vasodilatation In the laboratory, when l-norepinephrine is used from the start to maintain blood pressure in the face of hemorrhage, the re sults in terms of mortality are better than when the hypotension is not corrected by this means However, when this hypotension is permitted to last much longer than 5 minutes before l norepinephrine is administered, the mortality rate is not improved, in fact, the treatment may reduce chances for survival Reports have claimed beneficial effects in man from use of pressor agents that restore the blood pressure primarily by increasing peripheral vascular resistance

There probably are differences between the physiology of hypotension in man and that in the dog Nevertheless, after examination is made of available information on reported patients who survived or those who died after use of sympathicomimetic agents in hypotensive agents, the conclusion is that those who had serious abnormalities underlying the hypotension died, whereas those with relatively simple or trivial pathologic states lived

Acute Blood Loss Requiring 58 Transfusions · Use of Antigravity Suit as Aid in Postpartum Intra-abdominal Hemorrhage The modified antigravity suit (G-suit) consists of a large plastic inflatable bladder that is wrapped around the lower half of the body after the manner of a huge blood pressure cuff W James Gardner, Howard P Taylor and Donald F Dohn[9] (Cleveland Clinic) report on a woman, aged 36,

(9) J A M A 167 985 986 June 21 1958

who bled severely owing to placenta percreta. When the G-suit was applied, 18½ hours post partum, after two abdominal operations, she had received 10,000 ml. fluid and was receiving the 56th and 57th units of blood. During the first few hours in the G-suit, she received an additional unit of blood, making a total of 58 units in 24 hours. No more blood was needed. She showed type O, Rh+ blood and received only this type donor blood through treatment. The supply of banked blood was rapidly exhausted in this emergency, and thereafter the citrated blood that she received, still warm from the donor, probably contained a good number of platelets. She received 29,000 ml. blood in 24 hours.

The G-suit was used in another instance of postpartum hemorrhage, in which 20 transfusions were required in 20 hours to combat hemorrhagic shock. In this patient also, after application of the G-suit, only 1 additional unit of blood was required to restore and maintain the blood pressure level.

Intestinal Factor in Irreversible Endotoxin Shock. According to Richard C. Lillehei and Lloyd D. MacLean[1] (Univ. of Minnesota), evidence is increasing that endotoxins produce deleterious effect by inciting severe, lasting vasospasm in small arteries and veins. As in hemorrhagic shock, effects of this vasoconstriction are particularly severe in the bowel and there is progressive decrease in plasma volume and increase in hematocrit and plasma hemoglobin, which foretell hemorrhagic necrosis of the bowel noted at autopsy.

The authors report experiments on dogs in which several drugs (chlorpromazine, Dibenzyline®, metaraminol, norepinephrine and hydrocortisone) and antibiotics, enterectomy, hypothermia and fluid replacement for lost plasma were used to alter response to endotoxin.

The course before death and autopsy findings in dogs receiving intestinal antibiotics in no way differed from those in control dogs. Stool cultures before the experiment were sterile for aerobic and anaerobic organisms in 8 of 11 dogs; yeast was found in 2 and gram-positive cocci in 1.

Despite severe hemorrhage and an anesthetic agent that somewhat potentiates the deleterious effects of endotoxin, enterectomized dogs survived significantly longer than did the controls. In dogs pretreated with chlorpromazine, 25-50

(1) Ann Surg. 148:513-524, October, 1958.

mg./kg., the secondary blood pressure drop after 60-90 minutes was mild and mean pressure usually returned to normal by 4 hours after the endotoxin. Plasma losses and hematocrit increases were slight and only moderate rise in plasma hemoglobin occurred. At 24 hours after the experiment there was little change in these measurements over those in the first 8 hours and 6 of 10 dogs survived permanently. They did not have diarrhea and when killed, the bowel and lungs were normal though liver congestion and subendothelial hemorrhages in the left ventricle were usually present. In dogs given Dibenzyline®, the secondary blood pressure drop rarely went below 80 mm. Hg. By 4 hours after endotoxin, mean blood pressure returned to pre-experimental levels. There was little change in plasma volume or hematocrit and plasma hemoglobin levels increased only slightly. On the day after the experiment these dogs were usually alert in contrast to survivors treated with chlorpromazine, and all plasma measurements were at pre-experimental levels. These dogs did not have diarrhea and when killed the bowel and lungs were normal The only significant finding was liver congestion.

Hydrocortisone provided protection against endotoxin, which was even more conspicuous than with adrenergic blocking agents. The immediate drop in blood pressure rarely was below 85 mm. Hg and there was no secondary fall. There was no significant plasma loss or hematocrit increase. Plasma hemoglobin increased slightly, but returned toward normal in 24 hours. The only significant finding after the dogs were killed was congested liver, which was more pronounced in the dogs killed 1 or 2 weeks after administration of endotoxin than in those killed 1 or 2 days afterward.

Whether hypothermia was induced just before or just after endotoxin was given, the results almost uniformly paralleled those in controls. Dogs given metaraminol with the injection of endotoxin followed an accelerated course to death. Autopsy showed extensive hemorrhagic necrosis involving the entire mucosa of the small and large bowel. Dogs receiving norepinephrine had survival time that was almost identical to that of the controls though systemic blood pressure was supported at normal levels throughout the experi-

ment. At autopsy the bowel was edematous and necrotic. Replacing plasma losses with whole blood or dextran maintained normal systemic blood pressure in early stages of the experiment, but was of little final value because survival was not influenced. Bloody diarrhea was especially severe in dogs receiving blood for replacement. Autopsy findings were identical with those in the controls.

Plasma loss, hematocrit and plasma hemoglobin increase and hemorrhagic necrosis of the bowel in irreversible shock due to endotoxin apparently result from sympathomimetic action. Agents with adrenergic blocking effect prevent these deleterious effects and prevent death, whereas vasopressor drugs commonly used to treat this type of shock are without effect or actually potentiate the reaction by increasing intestinal ischemia.

Intravenous Fat as Supportive Therapy after Severe Injuries was tried by Curtis P. Artz and Thomas K. Williams[2] (Univ. of Mississippi), using Lipomul' I.V., a commercially prepared fat emulsion. A 600-cc. bottle of the emulsion contains 90 Gm. cottonseed oil, 24 Gm. glucose, 7.2 Gm. soybean phosphatide and 1.8 Gm. polyoxyalkol, making up 960 calories. The emulsion is prepared by high-pressure homogenization and is sterilized in the final container by autoclaving at 15 lb. of pressure for 20 minutes. Most of the fat particles are under 1μ in diameter. The emulsion appears to be stable for at least 1 year if kept at about 5 C.

A total of 302 units was given to 28 patients. During 5 infusions, reactions such as nausea, chills and urticaria occurred. These reactions were minor, and the patients showed no untoward effects when reinfused with fat emulsion the next day. After 18 infusions in various patients a benign rise in temperature to above 100 6 F. was noted. Only 1 patient showed a serious response, which consisted of jaundice after 24 infusions.

Metabolic balance studies were done on several patients. Data on 6 typical patients show the protein-sparing effect of intravenous fat emulsion. This preparation appears to be a useful adjunct in patients with injuries and in others who are unable to take adequate calories by mouth

Moderate quantities of fat emulsion seem to be safe for

(2) Am J Surg 95 651 658, April, 1958

clinical use, but large quantities may evoke a severe response. Interference with liver function and the coagulation mechanism after intravenous fat emulsion infusions over a prolonged period is the primary problem.

During the past 5 or 6 years, hundreds of patients have received intravenous fat emulsions, with no evidence of fat embolism. It has been reported that the serum cholesterol level does not rise, but actually falls, after intravenous fat emulsion and that in some hypercholesteremic diseases, it is possible to reduce cholesterol levels.

Use of Intravenous Fat Emulsions in Surgical Patients. Frederick W. Preston and George C. Henegar[3] (Northwestern Univ.) report recent experiences with an improved intravenous fat emulsion, Lipomul® I.V., consisting of cottonseed oil 15 Gm., soybean phosphatide 1.2 Gm., polyoxyethylene polymer 0.3 Gm., dextrose 4 Gm. and water to make 100 Gm. Over 90% of the fat contained in the emulsion is in particles of submicroscopic size.

Febrile reaction is the commonest unfavorable response to intravenous fat. Characteristically, the temperature becomes elevated several hours after the infusion is begun, then falls within 2-6 hours after onset and does not rise again. Often it is accompanied by a chill. The more serious the condition of the patient, the greater is the likelihood of fever. Prolonged use of the emulsion may lead to the fat overloading syndrome, which is characterized by fat accumulation in the liver and hypocoagulability of the blood. These are the most serious toxic effects.

Evidence that intravenously administered fat is metabolized in a manner identical to orally ingested fat comes from four types of experiments: (1) respiratory quotient and oxygen consumption experiments, (2) radioactive isotope labeled fatty acid experiments, (3) weight gain studies and (4) metabolic balance studies.

Lipomul® I.V. may be given in amounts of 500-600 ml. daily for at least 14 consecutive days. This amount supplies 800-960 calories/day. 1,000-1,200 ml. of this preparation may be given daily to increase caloric intake, but it must be given slowly and probably should not be given for more than 7 consecutive days. More than 1,200 ml. should not be

(3) S. Clin. North America 39:145-159, February, 1959.

given in a single day. The rate of administration is the same as for dextrose and saline solutions

Persistent lipemia 24 hours after an infusion of a fat emulsion may be a contraindication to intravenous fat

► [This agent has now had extensive clinical trial and appears satisfactory for general use —Ed]

Studies in Metabolism of Trauma: III Postoperative Sodium Retention H E Jorgensen and J U Schlegel[4] (Univ of Rochester) studied two groups of patients controls, 18 patients who in the postoperative period were given 2,000-3 000 cc of 5% dextrose in water, and the urea group, 29 patients who in part of the postoperative period were given about 3,000 cc of 5% dextrose in water with 4% urea and 80 mEq sodium chloride Balance studies were carried out for the day of operation and 3 postoperative days

Sodium excretion in the postoperative patients was slightly higher when diuresis had been promoted by administration of 4% urea solution The commonly described postoperative sodium retention was thus prevented It might be expected that sodium retention without water retention would result in increase in serum sodium concentration, whereas sodium as well as water retention could maintain or lower the concentration The controls, receiving only 5% dextrose in water, gained weight and their serum electrolytes became diluted This is a common postoperative pattern The best explanation for the commonly observed decrease in serum sodium postoperatively is dilution secondary to water retention

It has been suggested that decrease in serum sodium concentration, as such, will provoke sodium retention in the postoperative period This theory was substantiated by the fact that the controls had increasing positive sodium balance on the 1st and 2d postoperative days, after drop in serum sodium on the day of operation No such retention was present in the urea group on the same 2 days

Other types of sodium retention, such as noted in patients with renal damage or on steroid therapy, are not prevented by administration of 4% urea Whatever the role of aldosterone is, it appears that the postoperative sodium retention found in the controls is at least in part secondary to the post-

(4) Surg Gynec & Obst 108 339 346 March 1959

traumatic antidiuresis Urinary sodium concentration does not differ significantly in the two groups so lack of sodium retention in the urea group appears to be due to the higher urine volumes This means that postoperative sodium retention can be avoided in the average patient if daily urine volume of 2 3 L is obtained by administration of 4% urea Such regimen will also prevent water retention and consequent serum dilution

► [It would appear from these studies that some of the changes in serum electrolytes occurring after operation previously ascribed to so called [illegible] response to the stress of surgery are in effect due to postoperative fluid restriction or artificial diuresis —Ed]

Aldosterone Excretion Following Trauma was studied by Eleanor H Venning, J R McCorriston, I Dyrenfurth and J C Beck (McGill Univ) The physiologic and metabolic response to gastrectomy showed, essentially, a similar pattern in the 3 patients studied, although the intensity of this response varied depending somewhat on the extent of the operative damage These patients were in a good nutritional state preoperatively and on the day of operation all showed an immediate rise in the excretion of 17-hydroxycorticosteroids and aldosterone The former remained at a high level for several days then gradually returned to the preoperative level

The patient (F K) who had the most extensive operation showed the greatest response, and the subsequent metabolic and endocrine changes were those associated with the development of surgical complications

In all these patients, aldosterone excretion rose to significantly higher levels on the day of operation In 2 this increase lasted for 1 day only, and on the 2d postoperative day the values were within normal range All 3 showed a later rise in aldosterone excretion in patient F K this appeared to be associated with recurrence of vomiting and development of dehydration and in another patient with wound infection

Despite the increased output of aldosterone on the day of operation only patient F K showed significant sodium retention on this day This patient received a much greater intake of sodium on this day than did the other 2, which might account for the excessive re[illegible] After the day of operation all 3 patients showed [illegible] retention of sodium

(5) Metabolism 7(pt 1) 293-300

for several days, though aldosterone excretion had decreased to lower levels. It would appear, therefore, that unless there is a delay in the effect of aldosterone on sodium metabolism, the sodium retention that normally occurs postoperatively cannot be attributed to the increased secretion of aldosterone. Other adrenal steroids, which are elaborated in greater amounts at this time, must contribute to this metabolic change.

There was an immediate loss of nitrogen and potassium after operation, the former being the more prolonged. The potassium-nitrogen ratio of the negative balance was greater than 3.5 on the day of operation in 2 patients, which suggested that more potassium was being lost than could be accounted for by protein catabolism. Since aldosterone causes potassium excretion in the adrenalectomized animal, this excessive loss of potassium might be associated with the increased aldosterone secretion.

A marked reduction in urine volume with a corresponding rise in specific gravity, which lasted 24-48 hours postoperatively, was also observed in the 3 patients. The sodium retention that occurred later was not associated with increased urinary concentration.

In this study the initial increase in aldosterone excretion observed after operation occurred at a time of adrenal stimulation. As other factors which tend to suppress aldosterone excretion come into play, such as sodium and water retention, reduction in secretion of this hormone follows.

In studies carried out on 2 patients after fractures, no urine was obtained on the day of injury. Aldosterone excretion appeared to be depressed, however, for several days after the accident.

Effect of Removal of Major Endocrine Glands on Serum Level of Magnesium in Dogs was studied by Peter Weil and David State[6] (Cedars of Lebanon Hosp., Los Angeles) to determine whether magnesium metabolism is under hormonal control. Attempts to correlate the serum level of magnesium with the serum levels of other electrolytes have been reported, but findings have not been uniform. A review of the literature has revealed that the body mechanisms regulating magnesium metabolism are still largely unknown.

(6) Surg., Gynec. & Obst 107 483 488, October, 1958

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(5) Metabolism 7(pt 1) 293 300 July 1958

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(6) Surg., Gynec. & Obst. 107:483-488, October, 1958.

Surgery was done on 22 mongrel dogs, of which 2 had total bilateral parathyroidectomy, 4 simultaneous thyroid parathyroidectomy, 4 hypophysectomy, 2 bilateral orchiectomy, 2 total pancreatectomy, 6 total adrenalectomy and 2 gastric resection, used as controls Serum magnesium levels were determined up to 2 months after surgery In most dogs, serum calcium, potassium and sodium values were also determined simultaneously

Results showed that only in the dogs with adrenalectomy and thyroid parathyroidectomy were the magnesium levels appreciably altered In those with total adrenalectomy serum magnesium increased, whereas with thyroid-parathyroidectomy it was significantly decreased The low magnesium values coincided with clinical manifestations of tetany Convulsions disappeared after serum magnesium had spontaneously returned to normal, even though serum calcium remained low

It would appear that aldosterone might be a regulatory hormone for serum magnesium as it is for serum sodium and potassium Other investigators have found that, under normal conditions, at least 95% of the filtered magnesium is reabsorbed by the tubules If aldosterone is necessary for regulation of reabsorption of magnesium, then removal of the adrenal glands should result in less urinary excretion of magnesium and higher blood levels The effect of adrenalectomy on serum magnesium appears identical to its effect on serum potassium This concept was supported by the fact that hypophysectomy did not alter magnesium levels and it is in agreement with the prevailing view that aldosterone secretion and activity is independent of the pituitary

Low magnesium levels are found in patients with chronic alcoholism, especially in those with delirium tremens and hepatic cirrhosis Impaired inactivation of aldosterone as a causative factor for the hypomagnesemia as well as the sodium and water retention in cirrhosis has been suggested by an earlier report and may be a possible explanation

Safety of Liquid Plasma—Statistical Appraisal Wynn A Sayman, Ross L Gauld, Shirley A Star and J Garrott Allen[7] did follow up studies in three categories of patients who received transfusions at the University of Chicago

(7) J A M A 168 1735 1739 Nov 29 1958

those receiving pooled plasma without whole blood, those receiving plasma plus blood and those given blood without plasma. Complete follow-up was possible for 98% or more of the patients comprising each group.

Attack rates were evaluated for serum hepatitis, with jaundice, as compared with the number that should have been encountered had the pooled plasma been infectious (icterogenic). Among 305 patients receiving pooled plasma without blood no cases occurred, whereas 48 would have been expected. The established attack rate for 653 patients receiving plasma plus blood was 3.2%; 123 cases would be expected in this series, with 24 from blood received, but 21 cases were found or nearly the number expected. The attack rate among 1,894 patients receiving blood without plasma was 2.3%; in this group, the average patient was exposed to 3.0 units of blood, whereas the blood exposure for those in the group receiving plasma plus blood was 5.7 units, irrespective of the plasma that was also given. The slightly higher attack rate for the plasma plus blood group as compared with those receiving blood alone was therefore to be expected. Pooled liquid plasma was not to be incriminated in any patient as the cause of serum hepatitis.

The probability that the results obtained in this clinical study could have occurred by chance alone, computed statistically, proved to be less than 1 in 1,000. The statistical method reported in this study is but one of several that were applied; regardless of the method used, the conclusions remained unchanged.

There is little chance that pooled liquid plasma will produce serum hepatitis after being stored about 6 months at average temperature of 89 F. (31.6 C.). Provided adequate bacteriologic safeguards are used to insure sterility, this procedure will enable preparation of pooled plasma that is essentially free from the risk of transmitting serum hepatitis.

When these same conditions prevail in plasma preparation, except that the temperature is 9.2 C. lower (22.4 C. or 72 F.), serum hepatitis can be transmitted despite 7 months of storage. Daily temperature records are therefore essential to the safety and success of the procedure.

► [This method of inactivati... [illegible] ...rum hepatitis has now been [illegible] ...blood replacement therapy. [illegible] ...article, that pasteurization

may be equally effective with the additional advantage of greater ease of preparation Certainly there is adequate justification for more clinical experience in this direction —Ed]

Clinical Trial of Pasteurized Pooled Human Plasma is reported by William C Levin, Truman G Blocker, Jr, E Frank Dunton and Melvin A Casberg[8] (Univ of Texas) The plasma, treated by heating to 60 C for 10 hours to inactivate the serum hepatitis virus, was administered 35 times to 30 patients No immediate untoward consequences were observed No subjective or objective evidence of anaphylactoid or other allergic episodes, no symptoms suggestive of significant hemodynamic changes, no pyrogenic reactions, no clinical or laboratory evidence of hemorrhagic diatheses and no significant alterations in serum protein levels were noted

In previous trials, 130 units were given to 84 patients, with 22 readministrations after 1 month Two patients being treated for pulmonary tuberculosis had chest pain Two patients felt "chilly," without objective evidence of reaction, and 6 hours after infusion, 1 had slight temperature elevation (100 6 F) which lasted a few hours Schultz-Dale tests on serum from 11 of these patients showed negative results in all

These experiences and previously reported evidence of efficacy of pasteurization in inactivation of serum hepatitis virus probably assure the long term safety of this preparation, inasmuch as pasteurization of serum albumin has been satisfactory by the same method These clinical trials also suggest that it exerts a satisfactory oncotic effect, with production of almost a calculated optimal increase in plasma and blood volumes in normal recipients, with maintenance of this effect for at least 24 hours More extensive clinical trials in patients who require blood volume expanders are needed

Removal of Excessive Potassium and Ammonium from Bank Blood Prior to Transfusion *by cation exchange resin* is described by David Charles Schechter Thomas F Nealon, Jr and John H Gibbon, Jr[9] (Jefferson Med College) There is progressive increase in ammonium and plasma potassium in blood stored in siliconized vacuum bottles and plastic

(8) U S Armed Forces M J 9 1249 1256 September 1958
(9) Surg Gynec & Obst 108 1 6 January 1959

containers These ions accumulate more rapidly in blood decalcified by passage through an ion-exchange column than in blood to which A C D solution has been added

METHOD—The resin columns consisted of 50 Gr. Dowex 50-X8, sodium cycle, supported on 100 mesh nylon bolting cloth in a vinylite casing The columns were connected to the blood containers (Fig. 1) Cold blood was passed over the resin at room temperature to simulate conditions prevailing during most clinical transfusions Rate of flow of blood through the resin pack was 50 ml /minute

Analysis of blood for ammonium, potassium and sodium

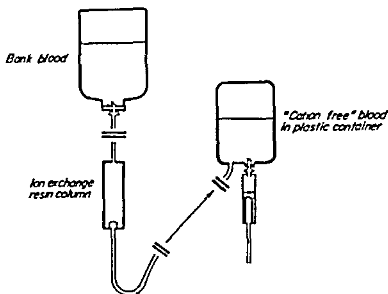


FIG 1—Ammonium and potassium ions are extracted by passage of bank blood through sterile resin column in series with container Effluent blood may then be given directly to a patient (Courtesy of Schechter, D C *et al* Surg, Gynec & Obst 108 1 6 January, 1959)

showed that potassium was reduced to below initial levels and ammonium to about normal levels There was a concomitant small increase in sodium Ammonium and potassium were removed to the extent of 74% and 94%, respectively Increase in plasma sodium averaged 11%

Administration of stored blood is potentially dangerous in patients with renal damage, severe tissue injury and liver damage This simple method is recommended as an effective means for removing excessive potassium and ammonium from the blood bank

Serum Hepatitis from Whole Blood: Incidence and Relation to Source of Blood Calvin M Kunin[1] (Harvard Med School) investigated whether an apparent increase in inci-

(1) Am J M Sc 237 293 303 March 1959

dence of homologous serum hepatitis noted during a single year at the West Roxbury (Mass) Veterans Administration Hospital was due primarily to use of blood supplied by a single commercial source A retrospective study was made of the hospital records on cases that occurred during 5 years and of all pints of blood used during that period The data suggested that one commercial source may have been responsible for more than its expected share of cases Two lines of evidence were available, the temporal relation of an increased number of cases during years in which this bank was the commercial source and an unexpected representation of pints of blood from this bank in patients in whom hepatitis developed subsequently Neither of these lines of evidence was conclusive

A similar study was therefore undertaken at the Boston Veterans Administration Hospital during 6 years This hospital had received blood from similar sources Once again an unexpected representation of pints from the suspect bank was found in data on cases of serum hepatitis This time comparison of the incidence of cases per 100 units during the years used when bank X supplied 28 5% of all pints of blood used and the years when a negligible amount was used revealed a difference in the attack rates significant at the 0 01 level The comparison for both hospitals on a similar basis was of borderline significance ($P = 0\ 05$)

These assumptions were made, which are considered valid for this type of comparison A representative proportion of patients with serum hepatitis receiving blood from each source reported back to each hospital for diagnosis and treatment *All patients included had true serum hepatitis resulting* from transfusion of blood Cases of serum hepatitis that occurred from needles, syringes and blood products were negligible or were balanced out The most valid estimate of the number of icterogenic pints used when multiple transfusions are given is based on the number of cases per 100 pt blood given, regardless of the number of pints received by the individual recipients The number of icterogenic pints missed in patients dying during the incubation period was negligible or balanced out A single pint was responsible for each case and the other pints received were not icterogenic This final assumption appears valid in view of the small

number of pints given to patients and the low over all incidence of the disease

Metabolic Alkalosis Following Massive Transfusion Martin S Litwin, Louis L Smith and Francis D Moore[2] (Harvard Med School) found that after massive transfusion with whole blood preserved in acid-citrate-dextrose (ACD) solution, usually immediate posttransfusion metabolic acidosis occurs due to the low pH of banked blood and poor tissue perfusion Initial acidosis is followed in several hours by gradual onset of a metabolic alkalosis, which is most marked on about the 3d posttransfusion day This alkalosis is due to the metabolic breakdown of sodium citrate, which is used as an anticoagulant in ACD solution The minimum amount of sodium citrate necessary to produce mild alkalosis after transfusion in hemorrhage is about 135 mEq This would be contained in 8 units of whole blood preserved in 600 ml ACD solution A or 1,000 ml solution B

Posttransfusion alkalosis represents, in a sense, the reverse of citrate intoxication, it is a result of the metabolic utilization of citrate Thus the alkalosis produced would be expected to have effects just the reverse of those of citrate on myocardial irritability, i e those of hypocalcemia, acidosis and hyperkalemia Minor citrate accumulation may be significant under special circumstances, quite aside from the massive accumulation usually associated with citrate toxicity This metabolic alkalosis is probably an effect to be desired In the ill postoperative patient or in the patient transfused after severe hemorrhage, alkalinizing therapy may aid in counteracting the metabolic acidosis that results from inadequate tissue perfusion Though evidence is not conclusive, there are data to suggest that in animals and in man in presence of hypovolemia, oliguria, hypotension and shock vascular homeostasis and recovery are more easily achieved in a normal or alkaline acid base setting than in severe acidosis The alkalosis of transfusion is believed to be an unintentional, but probably beneficial, by product of modern blood bank practice When pyloric obstruction coexists or there are other sources of alkalosis or hypokalemia this transfusion alkalosis may be of more dangerous significance

(2) Surgery 45 805 813 May 1959

Hemorrhagic Diathesis Associated with Massive Transfusion In the past decade, with increase in large scale operations and use of large volumes of blood for replacement, fatal hemorrhage of obscure origin has raised challenging questions During the Korean conflict this complication was noted in field and forward hospital surgery The syndrome became known as "hemorrhage due to massive transfusion" and serious indictment of large volume blood transfusion excited general concern Investigations have not yet indicated a common cause for the abnormal bleeding Open cardiac surgery with its concomitant need for massive blood replacement presents a unique opportunity to study this problem

S Gollub, A W Ulin, H S Winchell, E Ehrlich and W Weiss[3] (Hahnemann Med College) studied 38 patients who received large volume blood replacement in whom coagulation factors were determined Of 30 who had open cardiac surgery, 8 bled abnormally, and 8 who had closed cardiac procedures also bled abnormally Bleeders received a greater average total amount of blood as compared with nonbleeders, but up to the time when bleeding started, this was not the case Bleeders were given 6 0 and 4 6 L up to the time of bleeding, nonbleeders received an average of 5 4 L It appears therefore that massive transfusion is not a condition sufficient to produce hemorrhage

Examination of mean values of individual coagulation tests did not disclose any biologically significant differences in the platelets or plasma coagulation factors between bleeders and nonbleeders undergoing open heart surgery There were, however, consistent findings of lower values or greater relative decreases in various coagulation factors for bleeders Whether the summation of these individual nonsignificant differences is significant in the aggregate, such that the hemostatic mechanism of bleeders is significantly more impaired than that of nonbleeders, is not known Results of plasma recalcified time suggest such a tendency, though absolute differences are not impressive In further studies, the role of blood vasculature is being considered

The authors suggest reconsideration of the term "hemorrhage due to massive transfusion" and a generalized ap

(3) Surgery 45 204 222 February 1959

proach to the syndrome of "unexplained bleeding in the surgical patient"

Problem of Overtransfusion in Massive Hemorrhage was studied by John W Downs[4] (Little Rock, Ark) In circulatory overloading, within 1 hour of transfusion the patient suddenly becomes dyspneic, orthopneic and intensely cyanotic Blood-tinged frothy sputum may be coughed up Venous pressure is elevated, as indicated by engorgement of the jugular veins in the erect position, the lungs fill with sibilant and sonorous rales, and auricular fibrillation may occur The patient may die within a few minutes of onset of symptoms, depending on degree of overloading and ability to tolerate it Peripheral edema may develop if the patient survives some hours without treatment

Asthma is the only condition likely to cause confusion When it is necessary to administer large volumes of fluids at a rapid rate, repeated auscultation of the chest and gross determination of venous pressure should be done

Tourniquets tight enough to prevent venous return but not to occlude arterial pulsations should be applied to all four extremities They should be left in place no longer than 30 minutes at a time If stasis is necessary for over 30 minutes, the tourniquets should be released one at a time and then reapplied As soon as diagnosis is confirmed, phlebotomy should be done The amount of blood withdrawn should approximate that given if it is 500 ml or less

Positive pressure oxygen therapy is helpful in combating marked pulmonary edema Patients are more comfortable and less cyanotic when the mask is in use Fluids should be restricted to the minimum to produce an adequate urinary output and should contain no electrolytes unless a specific electrolyte deficiency exists Frequent tracheal aspirations are used to remove fluid accumulations

Immediate, Nonhemolytic Reactions to Blood Transfusion Analysis of Series of Transfusions Olof Ramgren, Erik Skold and Jan-Egon Tengberg[5] (Stockholm) found that the incidence of reactions associated with 6 899 transfusions administered during 1955 was 411 (5 96%) The rate for febrile reactions was 3 55%, for allergic 1 2% and for other

(4) Ann Surg 148 73 80 July 1958
(5) Acta med scand nav 162 211 223 1958

reactions 1 2% No hemolytic reactions due to serologic in compatibility occurred

Cases in which reaction occurred were compared with a control group in an attempt to elicit criteria for predicting risks of reaction Hemolytic and other nonposthemorrhagic anemias show a high reaction rate Nephropathic anemias and posthemorrhagic conditions of blood deficiency, con versely, show a strikingly low rate With respect to malig nant tumors, no difference exists between the two groups Pa tients with nephropathies tolerate transfusion well, despite the large numbers of transfusions administered to many of them Otherwise, the incidence of reaction increases with the number of previous transfusions In cases in which the *pretransfusion sample reveals rouleaux formation, there is* a clearly increased febrile reaction incidence The sedimen tation rate appears to be without significance in this respect In allergic reactions the pretransfusion sample provides no guidance *In this series age of the blood does not appear* to affect reaction rate if administered within 14 days If a patient has a certain type of reaction after blood transfusion an increased risk of reactions of the same type may be ex pected from subsequent transfusions

Six-Year Study of Incompatible Blood Transfusions Lee S Binder, Victor Ginsberg and Merel H Harmel[6] (State Univ of New York, New York City) report 30 cases among 81,392 transfusions Incompatible blood transfusion reac tions were classified into 5 major groups In group A, 10 pa tients were known to have had transfusions with incompati ble blood, but laboratory evidence of hemolysis was not shown Nine showed incompatibility in the ABO system Rh antigens were involved in 1 Seven of the patients had clinical symptoms suggestive of an incompatible transfusion reaction In 5 patients to whom B positive blood had been given symptoms developed after transfusion of less than 100 cc blood and in 1 after only 5 cc Three patients who showed no clinical reaction received 0 positive blood, prob ably of low antibody titer

Group B included 6 patients with free hemoglobin in the blood and urine, but with normal output Of 4 who had symptoms with the smallest volumes of blood, 3 had re

(6) Surg Gynec & Obst 108 19 34 January 1959

ceived group B blood. Two had evidence of hemolysis with apparently compatible blood. The symptoms were variable in number, severity and duration, but all the patients recovered.

In group C, 3 patients had oliguria lasting 48 hours or less; 1 died. In 6 patients in group D oliguria lasted over 48 hours; 1 died. One patient showed Rh incompatibility and in this group was 1 of 3 in whom the transfusion reaction was associated with hypertension.

In 5 patients in group E, intractible bleeding developed with incompatible blood transfusion; all died. Only 1 survived long enough (5 days) for kidney damage to contribute to his death. In 3 patients, hypotension was a prominent initial finding; 1 became hypertensive; and in 1, blood pressure remained normal.

The pathogenesis of acute renal failure that can result from an incompatible transfusion is unresolved. Several factors may act singly or in concert to produce renal ischemia: (1) shock, (2) effect of hemoglobin, (3) blood loss, (4) anesthesia, (5) levarterenol bitartrate. These factors could not be correlated with production of kidney shutdown in this series and they do not seem to have prognostic significance.

The clinical course of a hemolytic transfusion reaction is divisible into four phases: an initial phase of clinical symptoms; interval phase of apparent clinical improvement associated with oliguria; renal failure identified with stupor, convulsions and coma; and recovery heralded by abrupt onset of diuresis. Each is variable in severity and duration and one or more may be clinically insignificant or lacking entirely. As the patient progresses through each phase, therapy is varied to meet the changing clinical problem.

Education of the responsible physician to more careful and thoughtful use of blood has the greatest potential for ultimate reduction of incompatible blood transfusions. Less than half of the patients in this series receiving incompatible blood had transfusions that were indicated. Indications were questionable in 53%. Only 14 of the 30 transfusions were given for what was thought at the time to be an emergency. Of the 14 indicated transfusions, 11 resulted in mild reactions, but 73% of the severe reactions resulted from nonindicated blood transfusions. Of 7 patients who died, in 6

death was associated with transfusions of questionable necessity

► [This article, along with the others immediately preceding it, points up again some of the important and even fatal complications associated with blood transfusion The ready facility of blood transfusion in modern practice, its unquestioned need and efficacy in many conditions and its relative safety have undoubtedly led to a tendency to overuse this valuable agent Such articles as these however, serve a remindful purpose concerning the untoward effects of blood transfusion and emphasize the need for serious consideration of the indication of each unit of blood to be administered —Ed]

Postsurgical Anuria· Experimental Study of Fluid and Electrolyte Changes was done by B F Rush, Jr, and H T Randall[7] (New York) to measure and evaluate the shifts of fluid and electrolytes that occur in acute and total anuria after surgical procedures Observations in 9 dogs are tabulated and discussed Methods employed included serial determinations of plasma volume and the space of distribution of sucrose and inulin, determination of changes in the concentration of plasma electrolytes, estimation of intracellular (muscle) water and electrolytes by serial biopsy and tissue analysis, metabolic balance studies, and estimation of total body potassium by radioactive potassium dilution studies

Anuria was produced in the dogs by ligature of the ureters Studies of intra- and extracellular fluid spaces and electrolytes were done before and usually 72 hours after onset of anuria In all but 1 dog fluid intake was restricted to about half the insensible loss

It was found that, during anuria, total extracellular sodium, chloride, carbon dioxide and pH decreased, whereas extracellular potassium, phosphate and magnesium increased Intracellular sodium and chloride increased With fluid restriction, plasma volume decreased, inulin or sucrose space decreased both in the entire animal and in muscle biopsies, and intracellular water increased Balance studies indicated that loss of chloride from the extracellular fluid could not be accounted for in extracorporeal losses Total available body potassium remained the same before and during anuria

Under the experimental conditions established, it was felt that there was a shift of fluid and electrolytes from the ex-

(7) Surgery 44 655 665 October 1958

tracellular space into the cells with extracellular dehydration, hyponatremia and hypochloremia correlated with intracellular edema, hypernatremia and hyperchloremia.

Cation Exchange Resins in Treatment of Hyperkalemia. According to Harvey R. Bernard, John C. Fletcher and Charles F. Humphreys[8] (Washington Univ.), exchange resins can be used effectively in treatment of uremia and in some instances their use has obviated the need for dialysis. Exchange resins adaptable to treatment of uremic hyperkalemia have two components: the resin base and the attached groups that bind the exchangeable ions. In general, the resin base consists of long-chain polymers, cross-linked by shorter molecules, forming a lattice structure so constituted as to be inert and completely insoluble. The surface area of the resin may be expanded by decreasing particle size, grinding or limiting polymerization. Active groups of cation exchangers are bound to the resin base at multiple sites and consist of strongly ionized (sulfonic) or weakly ionized (carboxylic) acids. Most of the exchange resins now being manufactured have exchange capacities of 3-5 mEq. cation/Gm. dry resin. The type of ion used to charge the resin has not been of clinical significance; i.e., there were no obvious differences between use of sodium-charged and ammonium-charged resins. In no instance was significant alteration in extracellular fluid volume or osmolar concentration caused by use of sodium ion through exchange for potassium.

In treating over 40 patients with cation exchange resins, no adverse toxic effects were encountered. The only difficulties were of technical origin. Fecal impaction from concretion of resin particles has not been noted since finely ground resins were suspended in hypertonic (10%) dextrose solutions before introducing them into the colon.

Although exchange resins did not provide ideal treatment, a few patients with high serum potassium levels were successfully treated. Exchange resin treatment is started after the serum potassium rises above 5 mEq./L. or when steady rise is evident, even at lower levels. When these indications are followed, small doses of resin are used and can be given over many days. The effectiveness of cation exchange resin treatment of hyperkalemia is directly proportional to the

(8) A.M.A. Arch. Surg. 77 703-708, November, 1958.

skill and persistence of the person who gives the enema There is wide individual variation in the rate of extracellular fluid potassium elevation from patient to patient during acute renal failure due to previous state of potassium metabolism, unusual losses (extrarenal) of potassium and unusual sources of potassium gain through breakdown of transfused blood, destruction of tissue or unknown causes It is therefore next to impossible to predict the exact rate of potassium accumulation or time of onset of hyperkalemia Guided by careful clinical observation, small doses of resin (20 30 Gm daily) may be started almost immediately on discovery of renal shutdown, thus prophylactically removing the rather small daily accumulation of potassium If similar methods can be found for reducing the effect of other toxic factors in uremia, necessity for extracorporeal dialysis may be *still* further decreased Use of cation exchange resins sufficiently early in acute anuria or oliguria usually reduces the need for dialysis in treatment of hyperkalemia or prolongs the interval between dialyses

Artificial Kidney F M Parsons and B H McCracken[9] report on 82 patients who were dialyzed with an improved Kolff Brigham artificial kidney The rate of blood flow through the dialyzer has been increased from 200 ml a minute to maximum of 550 ml a minute, and the dialyzing surface area of the cellophane has been increased from 21 000 to 28 000 sq cm These alterations have improved the clearance rates of urea and creatinine by nearly 40% The dialysis which is carried out in a special room, is continued for 6 hours, but the whole procedure takes about 9 hours To fill the machine before use 2 pt stored blood that is less than 5 days old is required and to prevent clotting, a total of 14 000 units of heparin is given intravenously in divided doses during the dialysis

Acute reversible renal failure occurred in 63 patients and 45 were dialyzed Basic treatment was a dietary regime (400 ml water and 100 Gm glucose daily, with vitamins) The most consistent indication for dialysis was clinical deterioration particularly early mental changes nausea and vomiting The biochemical indications were blood urea nitrogen 180 200 mg /100 ml plasma potassium in excess of 7

(9) Brit M J 1 740 751 Mar 21 1959

mEq./L. and CO_2-combining power below 13 mEq./L. The metabolic response, estimated by daily rise of the blood urea nitrogen was remarkably constant in any one patient, and classification into mild (rise<15/mg./100 ml. a day), moderate (rise 15-30 mg./100 ml. a day) and severe (rise >30 mg./100 ml. a day) is suggested. Patients in the mild group were often managed successfully without dialysis, whereas those in the moderate group (mainly patients with complications of late pregnancy) usually required dialysis between the 6th and 10th days. Those in the severe group (mainly patients with trauma, accidental or surgical) often required dialysis as early as the 4th or 5th day. Among patients in the severe group, incidence of complications, particularly sepsis, was high and the mortality greater. Many of these patients were referred too late; earlier transfer might improve prognosis.

Metabolic response in the pregnant patients was reduced by 70% when 30 mg. norethandrolone (Nilevar®) was given daily. Administration of this steroid might largely eliminate the need for dialysis. Similar action has not been observed in other conditions. Nine uremic patients with reversible postrenal obstruction were dialyzed. Obstructions in the upper renal tract were relieved surgically after dialysis. Obstructions caused by the prostate gland were relieved by an indwelling catheter and dialysis was performed, operation being delayed until renal function improved.

In chronic renal failure, too few patients were treated for justifiable conclusions to be drawn. In those with acute renal failure of obscure origin, dialysis was used to maintain life while diagnostic procedures were being undertaken. If an irreversible condition was found, no further dialysis was performed.

Many types of artificial kidney are available. Some of these machines can also remove water from the patient by ultrafiltration (Alwall, Skeggs-Leonards and Kolff disposable pack), but unfortunately, their dialyzing surface area and hence, efficiency, is less than the modified Kolff-Brigham model used in this series.

Surgical Care in Post Traumatic Renal Failure. Benjamin F. Rush, Jr., Paul E Teschan and Roy Mundy[1] report on 8

(1) A M A Arch Surg 77 807 815, November, 1958

patients seen at a specialized treatment center in Korea An artificial kidney was used as an adjunct in controlling uremia and potassium intoxication Many patients had received massive wounds and showed large areas of nonviable tissue which it had been impossible to remove in initial surgery at forward hospitals

Group 1 consisted of patients with acute renal failure uncomplicated by accompanying tissue damage or infection In 1 of 2 of these patients, diuresis (rise in urinary output to over 1,000 cc daily after a period of oliguria, or output of under 500 cc) was re established with medical management only, in the other, it was re-established with medical therapy after hemodialysis A fatal outcome could not be averted in 4 in group 2, consisting of patients with acute renal failure complicated by massive tissue necrosis and/or infection, in whom infected necrotic tissue could not be adequately removed The outcome was satisfactory in 2 in group 3, comprising patients in whom acute renal failure was associated with severe tissue necrosis or infection, which was removed

Cases in group 2 illustrate that in tissues severely injured by infection or trauma, there appears to be a failure of normal homeostasis, with an outpouring of potassium and nitrogen and other intracellular constituents into the extracellular fluid In the patient unable to excrete these substances rapid rise in serum nonprotein nitrogen and potassium levels follows, and these changes are superimposed on serious imbalances already present due to renal failure and posttraumatic electrolyte shifts When infection cannot be controlled or when dead and dying tissue cannot be fairly completely debrided, deterioration is progressive One patient had repeated debridement of extensive wounds of the right thigh and buttock and right arm, but after each procedure necrotic tissue remained A total of 700 mEq potassium, about 18% of normal body stores, was removed through repeated hemodialysis, but rapid evolution of potassium intoxication was only temporarily affected

When all necrotic and infected tissue can be removed in patients with renal failure, as in group 3 patients, the course may be favorably altered and the patient may be salvaged, despite severe initial injury Excision of necrotic and in-

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In a surgically closed wound, epidermis does not unite at the surface by growing across the clot-filled defect, but migrates rapidly toward the depths of the wound on the cut surfaces of the dermis until it reaches a point of tissue continuity Here, advancing epidermal sheets from opposite sides meet and close the wound The epithelial junction becomes greatly thickened and tends to fill in the defect left by its inverted growth down the dermal edges Regenerating epidermis apparently secretes a proteolytic enzyme, a fibrinolysin, which facilitates its movement beneath blood clot and tissue debris and may be related to keratinization Epithelization of experimental wounds is regularly accomplished before connective tissue regeneration becomes apparent As the two tissues mature during repair, epidermal penetration of granulation tissue occurs Later, as new collagen appears, epithelial growth is realigned and epidermization occurs Regeneration of connective tissue occurs in situations well removed from the epidermis Regenerating epidermis probably exerts little control over contraction and granulation tissue formation other than that exerted by the cover it provides

As the cellular exudation of acute inflammation subsides, the fibroblast rapidly becomes the numerically dominant cell of the wound The first evidence of fibroblast activity appears in tissue adjacent to the wound At a time when the central region abounds with infiltrated leukocytes, fibroplasia is proceeding at the periphery in contact with inflamed areolar tissue Fibroblasts have three functional stages in the healing wound proliferation, collagen fiber formation accompanied by waning growth potential and appearance of fibrocytes, whose blast potential has vanished The mast cell is not always found, but its function and that of its secretory products, histamine, heparin and serotonin, are important in connective tissue metabolism

The second numerically and functionally dominant cell of granulation tissue is the endothelial cell After injury hemorrhage and thrombosis occur in the terminal vascular bed directly affected, with a peripheral zone of sludging and diapedesis of diminishing intensity Capillary proliferation occurs from these peripheral inflamed vessels Only in corneal healing does normal fibroplasia occur in absence of an

intimate blood supply, and only in scorbutic healing does fibroblast proliferation proceed without concomitant proliferation of capillaries. In corneal and abnormal avascular fibroplasia, special features of ground substance composition probably account for dissociation of cell growth and vascularity. Lymphatic vessels respond to inflammation by dilatation and intense proliferation. The ruptured lymphatic vessel after direct injury may not be sealed for several days, during which fluid and cells flow freely between the vessel and the tissue.

After dissolution and disposal of tissue debris in a wound and immediately before fibroblast proliferation, clear fluid accumulates, distinguished from early exudate.

In response to injury, intact ground substance rapidly takes up water and tends to change from a gel to a fluid that greatly enhances passage of particulate matter. The ground substance provides a central compartment between cells and the vascular system and consequently an obligatory pathway between cells of the healing wound and the rest of the body. Increasing evidence suggests that the sulfated mucopolysaccharides serve an important function in interfibrillary cementing of fibrous connective tissue.

Collagen fibers principally account for restoration of tensile integrity to a severed tissue. Collagen concentration and tensile strength of a wound normally reach an initial maximum value in 12-14 days in most species. Microfibrils appear to be formed outside the cell and their growth and aggregation lead to optically visible collagen fibrils and fiber bundles. Fibril bundling may depend in part on the numerical density of microfibrils in the tissue, in turn referable to the abundance of precursor collagen and cellular synthesis. Cellular density during the proliferative phase appears to be directly related to subsequent density of collagen fibers, whether estimated chemically or microscopically.

Closure of an open soft-tissue wound, unlike a sutured incision, depends largely on mobilization of surrounding tissue rather than on epidermal and connective tissue regeneration. Wound contraction is the major factor, areawise, in closure of a defect in tissue that is not splinted by underlying structures. The more nearly complete the contraction, the smaller the surface defect that must be bridged by

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the scar From this it follows that complete physiologic contraction altogether precludes the formation of a pathologic contracture

II Injury and abnormal repair—Edwards and Dunphy[3] point out that the principal factor in impaired healing is cellular privation, resulting from lack of essential nutrients, inaccessibility of metabolites from the rest of the body or inability of the cell to utilize them Common to scurvy, protein starvation, cortisone poisoning and radiation disease are defects in other systems of protein synthesis Hair growth is defective or deficient, antibody formation is inhibited, somatic growth is retarded and there is general wasting of body tissue No single biochemical lesion is paramount in the end effect of these conditions, but current knowledge highlights the defects in wound healing

Scurvy is marked by failure of fibroblast differentiation and impaired synthesis of collagen and sulfated mucopolysaccharides Exactly how absence of ascorbic acid is ultimately lethal to the organism is still unknown

Protein starvation is characterized by retardation of all phases of wound repair, but healing is ultimately accomplished even in terminally depleted animals Restoration of healing toward normal by methionine or cystine supplementation of the protein free diet emphasizes the importance of amino acid sulfur in healing, and this is doubtless an enzymatic function involving protein sulfhydryl groups True dimensions of the roles of osmotic derangement and individual amino acid deficiencies in the healing defect of protein starvation remain to be established

Administration of cortisone depresses cell respiration and division and synthesis of collagen and mucopolysaccharides in the wound Simultaneously, cortisone causes protein catabolism, and there is decrease in circulating amino acids Additive impairment produced by combining protein deprivation with administration of cortisone along with known effects of cortisone on permeability and diffusion, suggests that cortisone overdosage induces in connective tissue a form of cellular starvation Paradoxically however protein synthesis in the liver is increased by cortisone Perhaps related to this is the intimate contact between blood sinusoids and

(3) New England J Med 259 275 285 Aug 7 1958

the material should not create a condition that may favor bacterial growth Tensile strength should be high in the small caliber suture Knots should hold without fraying or cutting, threading should be easy The material should not shrink or fray and should be nonelectrolyte, noncapillary, nonallergenic and noncarcinogenic, and also inexpensive The material should allow easy sterilization by boiling or autoclaving without altering the suture The material might also be of a type that is absorbed with minimal tissue reaction after it has served its purpose Obviously, this ideal surgical suture material is not available

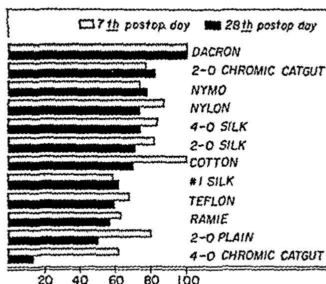


Fig 2—Percentage of original tensile strength retained on 7th and 28th postoperative days arranged in decreasing per cent retained on 28th day (Courtesy of Postlethwait R W *et al* Surg Gynec & Obst 108 555 566 May 1959)

Plain and chromic catgut, silk, cotton, wire, nylon, ramie nymo, Dacron and Teflon were studied in animals as regards tensile strength of the sutured rectus wound, histology of this wound, tensile strength of the implanted suture loop and grade of tissue reaction to the suture The catgut sutures were similar to the nonabsorbable sutures until absorption began At this time, tissue reaction increased and the tensile strength of the suture fell rapidly

Tissue reaction to Teflon was the least of any of the sutures studied and the tensile strength was satisfactory (Fig 2) A braided rather than twisted suture would probably decrease the amount of fraying, but, as with the other synthetic sutures, some alterations of the suture will be neces

sary so that the knot will be dependable. The favorable characteristics of Teflon are so evident that further work to overcome this one disadvantage should certainly prove worth while

Debricin: Clinical Experiences with New Proteolytic Enzyme in Surgical Wounds in 139 patients are reported by James F. Connell, Jr, Louis R M. Del Guercio and Louis M Rousselot[5] (New York Univ.). This enzymatic agent was developed from the ficin latex of the fig tree Although highly active against fully denatured protein, Debricin is only partially active on marginal necrotic tissues There has been no evidence of systemic toxicity and little evidence of wound maceration

In 106 (77%) patients, response was more prompt with less trauma, and in many instances with extraordinary results, than would be anticipated with other available proteolytic enzymes or surgical debridement In 19 lesions, results were fair and in 9, poor or ineffectual In 55 patients, the lesions were burns of various type and severity; 49 had ulcerated lesions; and 30, 16 of whom were surgical patients, had various wound infections

To obtain good results, Debricin must be kept in contact with the proper denatured tissue substrate The highly specific nature of this biochemical reaction must be kept in mind when selecting patients for therapy. The reactive process requires that the wound has adequate drainage and, if necessary, frequent replacement of enzyme, especially when it has to be applied to convex surfaces

The main purpose of enzymatic debridement is to provide a clean wound in the shortest period After this state has been achieved, the enzyme should be stopped and appropriate surgery for wound closure carried out Enzymatic debridement is primarily an ancillary tool to surgical therapy and not necessarily a replacement In many instances in which both technics can be carried out concomitantly, more rapid results will be obtained

Debricin is not bactericidal and should be accompanied by parenteral antibiotics, especially when used in large contaminated wounds Further studies on local enzyme-antibiotic combinations are in progress

(5) Surg Gynec & Obst 108 93 99 January 1959

Skin Degerming Agents with Special Reference to New Cationic Iodophore. Arthur W Frisch, Gordon H Davies and William Krippaehne[6] (Univ of Oregon) tested a number of skin degerming agents by the scrub index introduced by Blank and co-workers in 1950 and obtained the following indexes soap 173, Septisol 151, aqueous Zephiran® (1 500) 96, pHisohex® 94, N-methylheptylcolaminoformylmethyl-pyridinium chloride 58, the iodophore Virac 19 and ethyl alcohol (70% by weight) 1 7 Under the experimental conditions of testing, hexachlorophene and alkylbenzonium chloride were only slightly more effective skin degerming agents than Ivory soap

Before Virac was used in the scrub experiments, preliminary tests established that it demonstrated antibacterial activity when concentration of iodine was reduced to as little as 5 ppm Later it was shown that Virac killed Mycobacterium tuberculosis, spores of Bacillus subtilis, Candida albicans, Micrococcus aureus, influenza A virus, poliomyelitis virus and Trichomonas vaginalis in use concentrations From these preliminary tests, it was concluded that iodine was readily released from Virac and acted as the major disinfecting agent The quaternary also exhibited potent antibacterial properties characteristic of this group of cationic compounds In the scrubbing tests, Virac was definitely superior to hexachlorophene and benzalkonium chloride, giving a final index roughly nine times more efficient as a degerming agent than soap and water

Discriminate Antibiotic Prophylaxis in Elective Surgery is urged by E J Pulaski[7] (Letterman Army Hosp) The antibiotic chosen for protection during and after operation is preferably selected on the basis of prior bacteriologic studies The purpose of continuing therapy postoperatively is to control the remaining bacteria after debridement and drainage of infected tissues Postoperative therapy is desirable ordinarily for no longer than 3 days At this time the patient's condition is re-evaluated and a decision made as to whether therapy is to be interrupted, continued or altered

The objective of prophylactic antibiotic therapy in the contaminated patient is conversion into as nearly a "clean" cate-

(6) Surg , Gynec & Obst 107 442 446 October 1958
(7) Ibid 108 385 388 April 1959

gory as possible. Emphasis is placed on preoperative preparation and on judicious rather than exclusive use of antibiotics. Antibiotics should be used as an adjunct for standard surgical procedures, not as a substitute. Preoperative reduction of regional bacterial flora should be achieved by mechanical cleansing and adjunctive antibiotic therapy. Circulation should afford adequate, antimicrobial concentrations in the infected tissues. Seeding at operation should be prevented by proper quarantine. Postoperative antibiotic therapy should be unnecessary unless spillage has occurred. Antibiotic effectiveness is often nullified by tissue necrosis, hematoma, ischemia, presence of drains or foreign bodies, or dead space. After mechanical cleansing, the drug used is the one chosen by laboratory studies or in emergencies, and the one determined by experience to be the most effective.

A category exists in which antibiotic prophylaxis is probably warranted in delayed or nontreated cases. Examples are nonoperative treatment of acute pancreatitis, bleeding esophageal varices, acute cholecystitis, perforated peptic ulcer and active diverticulitis. It is questionable, however, whether one is actually using antimicrobial prophylaxis or therapy in these potentially explosive surgical cases. Nevertheless, evidence favors antimicrobial therapy in these instances. In the presence of infection, chemotherapy, not chemoprophylaxis, is needed before and after surgery. The antimicrobial agent used should always, when practicable, be selected on the basis of careful laboratory sensitivity studies of the organism involved.

Prevention of Wound Infection Following Contamination with Colon Organisms. A. O. Singleton, Jr., David Davis and Jerry Julian[8] (Univ. of Texas) observe that where there is sufficient time to prepare the bowel preoperatively by administration of oral antibiotics and sulfonamides, the bacterial flora of the bowel and incidence of infection should be greatly reduced. Great care in protecting the wound and avoiding contamination is of prime importance with or without bowel preparation. Edmiston demonstrated, in an experimental evaluation of intestinal antiseptics used for protection from fecal contamination during colon resection, that avoidance of contamination is more important

(8) Surg., Gynec. & Obst. 108:389-392, April, 1959.

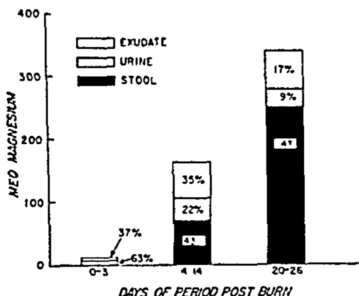


Fig 4 —Magnesium excretion in woman 45, with 60% total and 60% 3d-degree flame burn, died on 30th day (Courtesy of Barnes, B A, et al Ann Surg 148 755 766 November, 1958)

ords, no correlation can be made between type of exudate or condition of burned surface and amount of magnesium appearing in the exudate These exudate losses of magnesium generally lie between the amounts lost in the urine and in the stool and in 1 case contributed significantly to the negative balances

The departure of the magnesium-nitrogen ratios from the value generally ascribed to normal muscle (0 6 0 8) argues strongly for specific retention in or mobilization from the skeleton of magnesium

Treatment of Burns with Particular Reference to Local Care. Michael L Mason[4] (Chicago) emphasizes that local care of a burn begins just as soon as the patient's condition permits If no shock is present and adequate fluid replacement is started at once, the burn may be treated immediately Under strictly aseptic conditions, burn surfaces are first washed gently with soap and water After cleansing the wound and the surgeon changes gloves and gown, skin tags and blisters are removed from the surface with sterile instruments Excision is not carried out at this time

The author prefers the closed treatment, consisting of application of a thick absorptive compression dressing, which stops pain almost immediately A single layer of rayon, if

(4) Northwest Med 57 1439 1446 November 1958

lightly moistened with saline, is an excellent covering directly over the burn, it is transparent and so finely meshed that granulations cannot grow through it Absorptive layers may consist of fluffed gauze, covered with abdominal pads and kept in place with woven elastic bandages Immobilization is accomplished by the bulky compression dressings plus splints on the extremities, applied in functional position Intravenous fluids may usually be discontinued after 48 hours, then a diet rich in protein, 150 200 Gm daily is given, along with large amounts of vitamins, especially vitamin C (500 1,000 mg daily) In some severely burned patients, tube feeding by nasogastric drip is necessary Blood is given liberally during the first few days, then once or twice weekly, as needed

The burn usually is examined on the 5th to 8th day Facial and hand burns are usually uncovered by the 4th or 5th day Hand burns may often be excised and skin grafted at once Other burns are dressed on the 7th to 9th day If the injury is only deep dermal, dressings are reapplied and complete healing may be anticipated in another 7-10 days With only small spotty areas of 3d degree loss, these areas may be permitted to slough off and epithelialize spontaneously Occasionally, fairly good sized areas may be dressed every 2d day or so and the slough permitted to separate Free graft may then be placed over the defect This policy, however may lead to many weeks of delay in closure Another hazard of waiting is that areas of deep dermal burn may be converted into full thickness burns There is also danger of infection from repeated dressings

The most rapid method of slough removal is that of surgical excision under general anesthesia and with blood available Grafting is not often feasible at the time of excision because of bleeding Immediate grafting is often possible on the hand, on which the operation can be performed under tourniquet control, with application of a pressure dressing before release of the cuff

Evaluation of Fine-Particle Skin Autograft Technic Based on experiments in rabbits William A Cox and William W Nichol[5] (Brooke Army Hosp) found that split thickness skin autografts will survive 5 minutes of mincing in a food

(5) *A M A Arch Surg 77 870 874 December 1958*

Blendor and the cell homogenate will proliferate when placed on a raw defect It was difficult to determine the amount of skin coverage obtained because of continued contraction in size of the defect, which resulted from loose attachment of the rabbit skin to underlying fascia Three weeks after grafting, if the defect had contracted to 6×7 cm and was 60% covered with skin, the actual area of grafted skin was 6×7 cm times 60% or 25 sq cm, which is *about 2 5 times the area of the skin graft that was minced* and applied to the defect The increased edge surface of multiple small particles of homogenized autograft permitted epithelization to proceed from multiple points Many epithelial cells of the graft were broken up by the blades of the Blendor or sufficiently traumatized to cause death This may explain why greater coverage was not obtained Usually the cell fragments seen in stained smears were composed of groups of cells and occasionally an intact hair follicle Hair follicles were also found in biopsy specimens obtained from the center of the grafts In rare instances fine hairs were seen growing in the graft area

Because this technic does not give complete epithelial coverage initially or for several weeks after grafting, raw areas remain that result in fluid loss and provide portals for invasive micro organisms This grafting technic is unsuitable for primary coverage around joints or in regions where elasticity is necessary It might be of value in providing coverage for large immobile areas Cosmetically, the technic leaves much to be desired

Survey of Burns at Vancouver General Hospital from 1946 to 1955 is presented by *D E Yates, G B Stiles, R J Cowan* and *R G Langston* [6] During this period, 780 patients with burns (528 superficial and 252 deep) were admitted a few minutes to several months after injury Early in the series it was common to receive a patient burned 3 weeks or more previously, now a patient usually arrives within the first few days, and it is rare to get an old untreated burn Causes of burns were flame, 314, scalds, 237, chemical, 36, electric, 27, direct heat, 117, not stated, 49 Children under age 10 comprised one third of the total and had one third of the deep burns Mortality was 2 6% for children and 5% for

(6) Canad M A J 78 240 245 Feb 15 1958

adults (an inclusive rate of 4 2%) Adults received more extensive burns—usually *from flames, which caused 80% of* the deaths There were more deaths in patients under age 5 (7%) and over age 60 (12%) No patient lived in whom deep burns involved 45% or more of the body surface, and mortality increased when the burn exceeded 25% In the first 2 days after the burn, shock was the commonest cause of death, but pulmonary *edema was often associated* Pulmonary edema and bronchopneumonia predominated separately and together from the 2d to 11th day The most frequent cause of death from the 5th to 15th day was acute tubular degeneration of the kidneys, but this was occasionally associated with hepatitis or pulmonary involvement The single proved death from hepatitis occurred in a child, aged 10 *months, in whom the burn did not exceed* 10% of the body surface and who had received blood and plasma on admission Serum jaundice occurred in only 2 other patients given plasma, both recovered Two cases of septicemia were fatal Generally, there were no deaths attributable to inadequate management of the shock phase, although often no obvious program was being followed Early in the series there was a tendency to care for the burn surface be*fore shock was controlled, but now the latter is overcome* before local therapy is applied Smaller amounts of narcotics are being used, thus reducing the hazard of depression in elderly patients

Better understanding of the method of preparing the burn area for skin grafting has led to earlier grafting with resultant reduction in morbidity and hospital stay Average time of application of the first skin graft in 1947 was 36 9 *days, and in 1955, 22 6 days Recently, the burn* area has been prepared for grafting by debridement under anesthesia or by actual excision The skin graft is not applied until 2 or 3 days after excision The trend is toward a reduction in the number of grafting procedures and toward successful coverage of larger areas in a single operation This is reflected in the reduction of hospitalization for a deep burn from 73 3 days in 1946 to 46 4 in 1955

Mortality Rates in Patients with Burns Report of Experience at San Francisco City and County Hospital, 1943 56,

on the University of California Service, is presented by Albert G Clark and J Harold Hanson,[7] who reviewed 93 cases of burns covering more than 20% of the body surface Mortality increased from 40% in the period 1943-47 to 69% in the period 1952-56 Significant change in survival time was noted From 1943 to 1947, 69% of the deaths occurred within 48 hours of admission, from 1952 to 1956, only 19% of deaths occurred within the first 48 hours From 1943 to 1947, most deaths resulted from shock in the immediate postburn period, in later years, the major cause of death was infection

No patient over age 50 with burns over more than 25% of the body surface survived Only 1 with burns involving more than 45% survived No patient with a blood culture positive for bacteria survived Use of antibiotics had no effect on incidence of infection Elderly patients, children and alcoholics were less able to resist effects of infection The lowest mortality rate was in the group aged 15-35

The only change in antiseptic technic was increasing use of multiple, systemic antibiotics as prophylaxis and as definitive treatment, not only for burned patients but for surgical patients on the same wards During the period covered, there was an increase in resistant organisms and in serious and fatal infections due to organisms previously considered nonpathogenic or of low virulence Although increased age was a factor in the rising mortality, the authors believe that the increasingly early infection in burned patients, caused by organisms resistant to all antibiotics, also played a prominent role

The steadily increasing mortality, primarily due to infection, would seem to warrant establishing a separate ward for these patients Isolation technics should be used, and hospital personnel assigned to this ward should not be permitted to care for other patients Since the use of antibiotics prophylactically has had no effect on incidence of infection, these drugs should be reserved for therapeutic measures

► [Despite the acquisition of considerable additional knowledge about the burn problem through extensive investigations and the use of more effective therapeutic measures such as antibiotics and blood replacement therapy, there has been little or no appreciable change in mortality of extensive burns during the past several decades —Ed]

(7) California Med 89 210 214 September 1958

doing. It makes sense to speak of immunity to bacterial invasion, but immunity to implantation of tissues seems in many aspects to be a laboratory artificiality that resides in the methods of study, imposed by present limitations of knowledge, and not by the phenomena. There is satisfying evidence that living cells interact with each other and with their environment in specific ways, and that some of the interactions modify cellular structure and physiology, tissue morphology and organization, e.g., in the field of embryology. If these are kept in mind, along with broadening viewpoints of immunologists, some of the seeming artificiality and confusion of transplantation immunity may in time disappear.

Cells express their potentialities in ways strongly modified by their morphologic position and associations. Experimental embryology is replete with observations indicating that whether a cell differentiates, how it differentiates and to what extent, depend on environmental factors. Some if not all, of these intercellular reactions are mediated through "information" carried by the cells. Experiments suggest that some of this information is on the cell surface and some may depend on relatively large and complicated arrangements of constituent molecules. If so, it would not reflect on indications that lesser fragments of whatever is "arranged" may also be active or on the probability that because of their simpler nature, they might be first to be demonstrated and studied. If such information (antigen) is involved in tumor immunity, as it appears to be, it is not characteristic of the tumor as such because it is shared by normal cells. However, it is conceivable that one attribute of malignant cells is a disarrangement of such information so that the cells no longer react normally to their environment.

On a tentative and speculative basis, the sparse facts of tumor immunity may be looked on as fragmentary representations of broad biologic principles, broader than is usually implied by the term "immunity." Possibly in the past only special cases of general phenomena have been dealt with, which should be thought of in relation to development, differentiation and organism controls, as well as in relation to immunity. Such speculation led to the search for evidence

of specificity in gastric digestion. Experimental results encouraged retention of the working hypothesis that recognition systems may be widespread in biologic phenomena. How such systems operate is still largely a mystery, but many facts suggest they may be an important influence in cellular behavior. Cellular behavior poses the central problems in cancer and other biologic phenomena. All factors influencing cellular behavior are important and will remain so until knowledge of cancer is complete.

This viewpoint attempts to relate some of the artificialities of transplantation immunity to the realities of general biology and thereby remove some of the obscurity. This working hypothesis has led to experiments yielding interpretable results and may do so in the future. It has the philosophic virtue that it keeps open another possible approach to the problems of learning what a cancer is fundamentally and what might be done about it practically.

Role of Operative Stress on Resistance of Experimental Animal to Inoculated Cancer Cells (Walker 256 carcinosarcoma) was tested in rats by Peter Buinauskas, Gerald O. McDonald and Warren H. Cole[1] (Univ. of Illinois). "Takes" were observed in 61.1% of 85 rats subjected to celiotomy just before inoculation of cells and in 31.6% of 79 control rats inoculated with cells but not subjected to surgery. The control rats lived longer than those with celiotomy: at 35 days, 75% of the controls and 41.7% of the celiotomized rats were alive; at 90 days, 61.5% of the controls and 33.3% of the celiotomized rats were alive. The first discernible tumor usually appeared 8-12 days after inoculation in rats with celiotomy; in controls, about 3 days later. Tumors in celiotomized rats grew slightly faster than those in controls. The heaviest tumor in the celiotomy group after 90 days weighed 115 Gm.; that in the control group, 80 Gm.

These findings suggest that operative stress reduced the resistance of the rats to the inoculated Walker 256 cells Whether this reaction is sustained by human subjects is not known. At first glance, these data might appear to be a point against surgical therapy, but, si[illegible] is the most effective agent available for the [illegible]cer, if human be- [illegible] ction s[illegible] lts might be im-

proved by neutralizing the deleterious effect of operation on host resistance.

Local Chemotherapy of Experimentally Tumor-Seeded Wounds was studied by Arthur G. Ship, Richard V. Eck and Robert R. Smith[2] (Nat'l Inst. of Health). Formaldehyde in dilute solutions was very effective against tumor cells in vitro and in vivo against tumor cells implanted in artificially created open and closed tissue pouches in experimental animals. The site of surgical wounds in rabbits with implanted Vx2 carcinoma showed quantitatively less tumor growth when wounds were washed with 0.5% formaldehyde in saline than when they were washed with saline solution.

Air bubble wounds—tissue pouches created in the backs of mice—that were seeded with a known number of ascites tumor cells and treated at times ranging from 24 hours before to 24 hours after tumor inoculation with dilute concentrations of formaldehyde showed variations in the growth potential of tumor related to time of application of formaldehyde. Formaldehyde (0.05%-0.1%) applied at times varying from 5 minutes before to 24 hours after tumor inoculation prevented tumor growth in 80-85% of the animals, tumor growth occurring in 100% of untreated controls. In treated mice in which tumor developed, there was a significant delay in time of appearance of tumor. The same concentration of formaldehyde placed in the wound 1 or 24 hours before tumor inoculation resulted in enhanced tumor growth, with decrease in the latent period of tumor growth detection.

Host toxicity, as measured by motor impairment after exposure of nerves to dilute concentrations of formaldehyde, was shown. No nerve damage was produced in any rabbit treated with 0.5% formaldehyde, the same concentration showing a high degree of effectiveness against Vx2 carcinoma. In mice, a safety factor of 10 was demonstrated, the concentration of formaldehyde producing nerve damage being 10 times that therapeutically effective against tumor.

► [Steady advances are being made in the development of chemotherapeutic agents which may be of value in treatment of malignant disease, and currently an extensive cooperative study is being conducted for the clinical evaluation of various agents as adjuvants to surgery. Formaldehyde, which was used in this experiment, is only one of a number of agents

(2) Cancer 11:687-695, July-Aug., 1958.

which can be effective in preventing tumor seeding in experimentally produced wounds Considerable caution, however, should be exercised in the clinical use of these agents on the basis of animal experiments —Ed]

Chemotherapy of Cancer: Regional Perfusion Utilizing Extracorporeal Circuit. Chemotherapy of cancer has not been entirely satisfactory, because administration of doses large enough to affect a tumor sufficiently produce serious toxic defects on the bone marrow and gastrointestinal tract Oscar Creech, Jr, E T Krementz, Robert F Ryan and James N Winblad[3] (Tulane Univ) designed experiments to investigate (1) the extent to which certain vascular beds could be isolated from the systemic circulation, (2) the effects of perfusion of oxygenated blood alone and with chemotherapeutic agents added on these isolated areas, (3) the maximum amount of these agents that could be used safely in perfusion and (4) the duration of action of nitrogen mustard and phenylalanine mustard These investigations demonstrated that isolated tumor-bearing areas in the limbs, intestine, liver, pelvis and lungs could be perfused with chemotherapeutic agents for up to 30 minutes when a heart lung apparatus was used

Results in 24 patients with malignant neoplasms suggest that these methods are valuable adjunctive therapy for localized tumors and for palliation of far-advanced lesions A high concentration of the agent can be maintained within the tumor-bearing area without risk of systemic toxic effects There is no interference with hemopoiesis, and host antibody response to the neoplasm is preserved Ability to remove contaminated blood from the part after perfusion further protects against toxic effects when long-acting agents are used

Man, 76, with malignant melanoma and extensive cutaneous metastases on the thigh and leg was not considered to be a candidate for amputation because of his age and the extent of disease Perfusion of the involved extremity with phenylalanine mustard was undertaken for palliation only Blue dye studies demonstrated that the left lower extremity was completely isolated from the systemic circulation Perfusion lasted 23 minutes Within 3 weeks it was apparent grossly that the metastases were undergoing significant change Lesions became flattened and black then a superficial crust formed over their surface, the pigment began to fade and finally the crust fell away leaving a "light freckle" in place of the metastasis Biopsies revealed initial lymphocytic and round cell invasion of the neoplasm, followed by ne

(3) Ann Surg 148 616 632 October 1958

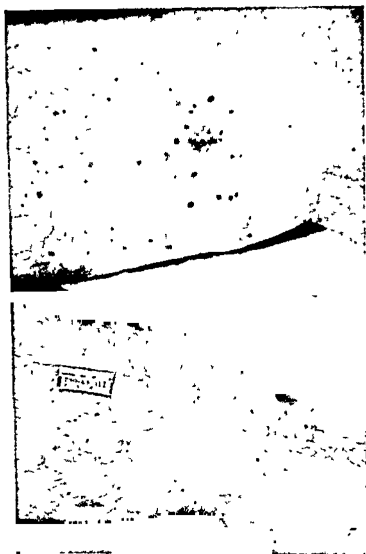


Fig 5 (top).—Cutaneous metastases before perfusion
Fig 6 (bottom).—After perfusion
(Courtesy of Creech, O, Jr, *et al* Ann. Surg. 148 616 632, October, 1958)

crosis of tumor cells and fibrous tissue replacement and finally by complete disappearance of tumor cells. The patient has been followed almost a year since perfusion. During this time metastatic lesions have continued to regress and disappear (Figs. 5 and 6). Only 8 (of the original 175) metastatic lesions on the extremity remained at last examination, and these were flattened and dark. No new lesions have appeared since perfusion.

► [Regional perfusion with chemotherapeutic agents using the extracorporeal pump-oxygenator illustrates how research in one field of medicine may be successfully applied in others Creech is to be commended for his imaginative application of this approach to the treatment of malignant disease His experience now includes more than 100 cases, and other centers including the M D Anderson Hospital, Houston, have also used this procedure in many patients The lesion which seems to respond most favor-

ably is melanoma, as indicated in this article. However, some remission has occurred in certain other neoplasms The exact place of this method of therapy in the total armamentarium of cancer therapy is yet to be determined Its usefulness ... gic nature of cancer and thus to provide ... ease may be of more importance than its ...

Molluscum Sebaceum and Its Surgical Significance (Synonyms: Keratoacanthoma, Molluscum Pseudocarcinatosum) are discussed by Sydney Thomson[4] (King's College Hosp, London). The nodule is hemispherical, clothed with normal skin except on the upper surface, on which is a thin, slightly depressed adherent scale. The scale is peeled off with difficulty, leaving a rough, irregular, almost papilliform undersurface. The scale is in fact the keratotic plug which is always firmly embedded The curved side shows no translucency but sometimes shows telangiectasia running up from the normal skin, which leads to the usual misdiagnosis of rodent ulcer. Occasionally, the tumor flattens as it grows. Resolution occurs largely by resorption, but larger lesions develop a black central eschar which separates to leave a superficial ulcer with a soft outer shell. At whatever stage the growth resolves—and it can disappear at any stage—it always leaves proportionate scarring (Figs. 7-9), which gradually becomes much less obvious with time.



Fig 7 (left) —Lesion in man, aged, 39, shown 5 weeks after onset, was allowed to heal spontaneously
Fig 8 (center).—Lesion 11 weeks after onset.
Fig 9 (right) —Lesion 13 weeks after onset.
(Courtesy of Thomson, S Ann Roy. Coll Surgeons England 22 382 400, June, 1958)

Rapidity of growth is characteristic. The patient may describe an antecedent comedone or a small boil or slight local damage, but when the nodule becomes evident it rises

(4) Ann. Roy. Coll Surgeons England 22 382 400, June, 1958

quickly above skin level and in 6-8 weeks is usually about 1 cm in diameter Lesions allowed to resolve spontaneously as a rule disappear completely in 1-5 months

If the growth shows signs of early regression, it is probably wise to leave it alone Some workers advocate radiotherapy, in doses of 100 6,000 r Many methods of direct destruction have been used, including liquid nitrogen Thomson believes, as do most authors, that some form of surgery is the treatment of choice Various methods include complete excision, simple curettage, sometimes followed by electrocautery or diathermy, simple curettage followed by silver nitrate as a caustic, cutting and coagulation diathermy, and curettage and light cauterization followed by 50% podophyllin and subsequent treatment with an ointment containing hydrocortisone and neomycin

Recurrent Basal Cell Carcinoma of Skin was observed by E A Van Slooten, J F Hampe and G Montanari[5] (Netherlands Cancer Inst, Amsterdam) in 81 (8 1%) of 1,000 consecutive patients with histologically proved primary tumor The recurrence rate was not influenced by the patient's age at time of initial treatment nor by sex Primary treatment in all was contact irradiation with x-rays and all were followed for 7 years Recurrences were commonest at sites where the surface of the skin shows deep grooves and bends sharply around corners, probably because of the difficulty in administering adequate tumor doses of radiation in such areas The recurrence rate was highest among superficial tumors, followed by noduloulcerative lesions, pigmented lesions tended less to recurrence Lesions with a short history have a greater tendency to recur than those present for several years

Over 50% of the recurrences were observed during the 1st year after initial treatment, with the number gradually decreasing in succeeding years After 7 years, there were still 6 (7 4%) patients with recurrence Late recurrences are generally easy to treat because of little infiltration into depth, therefore extension of follow-up beyond 7 years does not seem warranted

Of 81 patients, 21 had recurrence at the same site as the primary growth, 29 on the edge of the radiation scar and 27

(5) Arch chir neerl 10 329 349 1958

slightly beyond (paramarginal), localization in 4 was uncertain Marginal recurrences were commonest over bone or firm cartilage Paramarginal recurrences had a predilection for a soft yielding substructure Central recurrences had no such preference The chief determinant of type of recurrence is probably the histologic growth pattern of the primary tumor Subsequent recurrences in 28 patients were commonest in the paramarginal type

Of 31 patients treated by surgical diathermy, 14 (45 2%) had recurrence Of 48 who received irradiation, 12 (25%) had recurrence These disappointing results led to revision of treatment routine The first step is accurate, meticulous examination of all cut surfaces of a specimen because determination of spread is necessary in planning successful treatment Surgical exploration is the only acceptable approach because with irradiation and electrocoagulation no pathologic examination of wound edges can be made No wound should be closed before the pathologist's report is ready Combined surgical radiologic treatment can be carried out after the limits of the tumor are known and where large defects are to be avoided, but tissue to receive split skin grafts or to be used as flaps should not be irradiated

Reconstructive procedures generally are indicated in younger patients and in old people without perforating defects, but reconstruction of a nose, cheek, upper jaw and palate entailing repeated operations should be avoided In these patients, prosthetic repair affords many advantages

Leiomyosarcoma of Superficial Soft Tissues is a rare tumor that can develop in any of the major regions Arthur Purdy Stout and William T Hill[6] (Columbia Univ) reviewed data on 36 cases from various institutions throughout the United States up to 1956 During the same period 170 cases of leiomyoma of soft tissues were recorded Of the leiomyosarcomas, 9 were found in the region of the head and neck 6 in the trunk 5 in the upper extremities and 16 in the lower extremities (12 in the thigh) Most of these tumors are not large The smallest was 1 5 cm in diameter 20% were under 2 5 cm 20% were 2 6 5 cm and 60% were over 5 cm (Fig 10) The largest measured 16×9×8 cm weighed 660 Gm , was nestled among muscles on the poste

(6) Cancer 11 844 854 July Aug 1958

rior thigh of a woman, aged 63, and was adherent to the great vessels. Pain or tenderness is a feature of 80% of leiomyomas but was noted by only 2 patients with leiomyosarcoma.

Clinical evidence shows that leiomyosarcomas infiltrate, however circumscribed they appear. Of 32 patients who had excisions, 21 (66%) had local recurrences and some of the 11 without local recurrence died with metastases. Most of the tumors are solid, rounded or irregularly nodular growths.



Fig 10—Pedunculated tumor in subcutaneous tissue in man, aged 79, measured 12×5 5 cm after 3 years of growth (Courtesy of A. P. Stout, and W. T. Hill)

They do not undergo much necrosis and hemorrhages into them are not common. A high mitotic rate is the most valuable criterion for judging malignancy and an absence of mitoses is almost a guarantee that the tumor is benign. Leiomyosarcomas always have anaplastic cells, often show at least some bizarre cells and do not always show easily recognized myofibrils, whereas leiomyomas always do. When leiomyosarcomas metastasize, the favorite route is through the blood stream to the lungs. In this series, 19 patients had pulmonary metastases and 4 of these had additional involvement of regional lymph nodes Four with lung metastases also had extensive metastatic spread to viscera, skin, bones and dura.

A local recurrence rate of 60 6% is an indication of the inadequacy of primary treatment in many of these patients.

Complete removal of all the local tumor should be attempted at first treatment, with the hope that this can be done before distant metastases have occurred In a large tumor, careful biopsy in a bloodless field, followed by radical excision if the tumor is sarcomatous, is the proper procedure Boundaries of the excision should be well outside the palpable confines of the tumor everywhere, and the biopsy wound should also be excised If the tumor is relatively small, a curative type of excision can be performed without biopsy, but a generous amount of uninvolved tissue surrounding the mass should be excised When the tumor happens to develop in an area in which lymph nodes are found, such as the neck or axilla, it would probably pay to include the lymph nodes in tissue removed

Malignant Melanoma: Personal Experience with 170 Cases Ernest M Daland[7] (Pondville Hosp, Walpole, Mass) observed 91 females and 79 males, aged 2-84 (median 47) The lesions covered nearly all parts of the surface of the body (Table 1) About half the patients stated they had preexisting moles Many malignant melanomas probably arise without prior existence as moles Chronic irritation seems etiologically more important than a single trauma

Malignant melanomas may reach the blood stream early and spread to distant parts of the body—liver, lungs or brain—without ever spreading to the lymph nodes Other lesions spread via the skin lymphatics and still others by emboli through the deep lymphatics to the lymph nodes Some lesions may spread through both the blood stream and lymphatics.

The most radical method of treating malignant melanoma surgically is wide excision, followed by radical removal of the lymph nodes draining the area of the primary lesion Ideal as this treatment may be, it is not always possible or reasonable to carry out such a dissection The age or condition of the patient may be a contraindication It may not be possible to determine the exact direction of lymphatic spread, and in such cases it may be wise to defer dissection until nodes appear Of 22 patients in whom only local excision was done, 10 were well at 5 years There were no late recurrences or metastases In a primary case, the author

(7) New England J Med 260 453 460 Mar 5 1959

TABLE 1.—PRIMARY FOCUS

Location		No. Cases
Head and neck		58
Face	32	
Orbit	5	
Ear	8	
Neck	11	
Scalp	2	
Trunk		21
Back	12	
Abdominal wall	5	
Pubis	1	
Chest wall	3	
Upper extremity		32
Fingers and hand	2	
Forearm	19	
Upper arm	6	
Shoulder	3	
Axilla	2	
Lower extremity		59
Foot	28	
Leg	20	
Thigh	8	
Buttock	3	
Total		170

TABLE 2.—FIVE-YEAR RESULTS IN ALL PATIENTS TREATED FOR CURE

Result	No. Cases
Death from disease	31
Operative death	2
Patient living, with disease present, at 5 yr.	2
Untraced since treatment	2
Patient living, continuously free from disease, verified by medical examination, at 5 yr.	44 (52%)
Patient living, successfully treated for recurrence and free from disease, at 5 yr.	3
Total	84
Death within 5 yr. of other causes, without recurrence	4

performs local excision, with a skin graft if necessary. As soon as this wound is healed and free from infection, the regional dissection is performed.

Lesions of the upper and lower extremity are particularly suitable for unilateral regional dissection. Lesions on the trunk may require dissections of one or more groups of lymph nodes on one or both sides. Malignant melanomas of the head and neck may not metastasize or may spread into nodes on both sides of the neck and require bilateral radical neck dissection.

Table 2 lists the results of all operations in which cure

was attempted It includes patients with primary cases who had only excision, those with secondary cases with excision and those with both primary and secondary cases with both excision and regional dissections or only regional dissections The only surgical patients excluded are those in whom operation consisted in removal of recurrent or metastatic masses, performed for palliation, without hope of cure

Patients continuously free from disease for 5 years after local excision only comprised 55 5% The 5-year cure rate of all patients treated by local excision and regional dissection was 52 3% When lymph nodes were negative, the rate was 71%, when nodes were positive, 26% The 5-year cure rate when any attempt was made to eradicate the disease completely was 52 3% Only 3 patients had recurrences after 5 years Nearly all patients who died of disease did so within 3 years

This study does not settle the question of the necessity for precautionary regional dissection This is considered of greatest value in lesions of the extremities Too few patients did not undergo dissection for extremity lesions to give a parallel percentage of cures for the study

Studies on Melanoma II Sex and Survival in Human Melanoma Laurens P White[8] (Stanford Univ) studied 439 determinate cases of a total of 871 These cases were grouped according to site of the lesion (ocular or cutaneous) and by sex and age The distribution of melanoma was roughly equal in the two sexes and survival was better among women than men, this difference in survival being statistically significant Women have a greater chance than men for 5 year survival and prognosis for survival beyond 5 years even more strikingly favors women Prognosis for 5-year survival in both sexes decreases with advancing age out of proportion to the expected decrease in life expectancy with aging in the general population

From the present data and literature, no definite statement regarding the effect of pregnancy on the course of melanoma can be made Though pregnancy may adversely affect prognosis this effect has not been proved by adequate statistical study Statistics on 5 year survival in patients with melanoma though significantly better in women

(8) New England J Med 260 789 797 Apr 16 1959

than in men, do not adequately express the late course of the disease The most impressive differences in survival are in the group followed for more than 5 years, in which female survival is much greater The different prognosis for melanoma in men and women, which markedly favors female survival, the increasingly poor prognosis with advancing age, the benignity of melanomas in young children and the possible adverse effect of pregnancy on the disease course all suggest the likelihood of a hormonal influence on the growth of melanoma The nature of this influence, if actually present, is obscure

The fact that melanomas are equal in frequency in the two sexes argues against any crucial sex hormone effect on the genesis of melanomas If sex hormones do affect this tumor, it appears that the effect is on the environment of the metastases The hormonal influence, then, would be one of inhibiting the micrometastatic growth without preventing the process of metastasis per se At some later time of hormonal change, the metastasis present, but latent because of hormonal and other influences, would then become able to grow, manifesting its presence by clinical disturbance

Primary Lymphomas of Gastrointestinal Tract were investigated by Paul P Jackson and Campbell J Coady[9] (Univ of British Columbia) in 15 patients Reticulum cell sarcomas and Hodgkin's granulomas were by far the commonest In all lymphosarcomas the primary lesion appeared to be in the mesenteric lymph nodes, with only secondary involvement in the intestine itself There was 1 lymphoma of the stomach, 7 of the small bowel and 7 of the large bowel and rectum Only 2 lymphomas occurred in the terminal ileum One patient with Hodgkin's disease had what appeared to be 2 primary lesions, 1 in the jejunum and 1 in the terminal ileum (Figs 11 and 12)

The most frequent symptom was pain, occurring in 13 patients This was nearly always intermittent and crampy, caused by recurrent partial small bowel obstruction One acute perforation occurred in a reticulum cell sarcoma of the terminal ileum in a man, 67, whose only previous symptoms had been anemia and occult blood in the stool Six months previously a large benign rectal polyp had been discovered

(9) A M A Arch Surg 78 458-463 March 1959



Fig. 11 (top).—Hodgkin's disease involving both jejunum and terminal ileu
Fig 12 (bottom).—Hodgkin's disease of jejunum; enlarged from ×600
(Courtesy of Jackson, P. P, and Coady, C. J.: A.M.A. Arch. Surg 78:458-46
March, 1959.)

and removed by fulguration. The lesion of the termina ileum had not shown in barium series. The other acute per foration occurred in 1 of the 2 patients with Hodgkin's dis ease of the jejunum. None of the small bowel tumors wer diagnosed by barium meal.

A plasmacytoma was observed in a man, 27, who had ha intermittent pain, nausea and vomiting for about 1 year. A

transverse plaque in the lower jejunum was 2 cm wide and involved three fourths of the bowel circumference The patient died 5 weeks later of peritonitis, after intussusception of the anastomosis

Primary lymphomas of the gastrointestinal tract are uncommon Although prognosis is generally poor, it is not hopeless and more of these lesions than is realized may be resectable Perhaps awareness of the condition could lead to earlier diagnosis and resection, with possibly more cures

Diagnosis and Clinical Management of Functioning Carcinoids are reported by William G Sauer, William H Dearing and Eunice V Flock[1] (Mayo Clinic and Found) in 12 cases The syndrome of functioning carcinoid is being increasingly recognized as knowledge of it is being more widely disseminated The tumor functions in the same way as an endocrine tumor as a result of its secretion of serotonin The excess serotonin produces special symptoms, e g, spells of flushing of the skin, cramps, diarrhea and other less typical symptoms generally associated with intra abdominal tumors Demonstration of abnormal amounts of 5 hydroxy-3 indole acetic acid in the urine confirms the diagnosis Amounts of this substance may vary from time to time, and more than one determination may be necessary Postoperative urinary determinations are of value in suggesting the development of metastases

The primary lesion was located in the small intestine in 7 of the 12 patients—in the ileum in 5, in the jejunum in 1 and in an unrecorded part in 1 In 1 patient, it was in the cardia of the stomach, in 1 in the gastrointestinal component of an ovarian teratoma and in 3 in the lung, where apparently it was the carcinoid type of bronchial adenoma Tumor tissue from the lung contained 31 μg/Gm serotonin in 1 of the 3 patients and 86 and 62 μg/Gm in another (2 specimens) In 10 patients, qualitative tests for 5 hydroxy 3 indole acetic acid gave positive results and quantitative tests yielded amounts varying from 12 to 14 mg to over 280 mg in 24 hours In 1 patient with large amounts of serotonin in the urine and tumor, no signs of symptoms of functioning carcinoid were noted, despite symptoms of intestinal obstruction and demonstration of recurrent and

(1) J A M A 168 139 147 Sept 13 1958

metastatic tumor at operation Apparently some bodily mechanism furnished protection from the abnormal amounts of serotonin, although functional signs and symptoms probably will appear later

Treatment of choice is surgical removal of all, or as much as possible of, the tumor tissue to reduce the amount of serotonin secreted Irradiation is of doubtful value "Serotonin antagonists" have not been of aid in medical management Symptomatic measures for relief from diarrhea, pain and asthma are indicated

Carcinoid Tumors of Gastrointestinal Tract Jerome E Adamson and R W Postlethwait[2] review 26 cases observed during the past 25 years at Duke University Hospital Pathologically, the tumor cell (Fig 13), like its parent argentaffin cell, is small, of fairly constant size and typically epithelial Cords, rosettes, long strands and pseudoacinous formations are noted with an acidophilic material sometimes present in the acini Cells are cuboidal or low columnar Cytoplasmic granules having silver reducing properties and associated vacuoles surround a centrally placed, ovoid, well defined nucleus Mitotic figures are seen only in wildly malignant cases The cell membrane is indistinct Cytoplasmic vacuoles usually contain a lipid material The tumor stroma is composed of tightly organized fibrous tissue with little vascularity No true capsule is present, with a pseudocapsule composed of smooth muscle or fibrous tissue of surrounding structures Occasionally, fibrous tissue proliferation is evoked by the tumor from these invaded structures

Grossly (Fig 14), the tumor may be pale yellow or grayish tan, with this color related to the lipid material of the cytoplasmic vacuoles Ulceration of the mucosa usually does not occur except in large carcinoids They appear as a smooth to polypoid submucosal mass extending longitudinally and usually not encircling the gut Obstructive symptoms are often the chief complaint because of intraluminal polypoid projections of the tumor The serosal surface is least involved, with a typical indenting pucker revealing the underlying disease

Differentiation of malignant and benign carcinoid cannot

(2) Ann Surg 148 239 248 August 1958





Fig 13 (top) —Typical carcinoid with identifying features (Hematoxylin eosin reduced from ×226 2

Fig 14 (bottom) —Gross appearance of carcinoid of appendix obliterating lumen Tumor was bright yellow on section

(Courtesy of Adamson J E, and Postlethwait R W Ann Surg 148 239 248 August 1958)

be made on a cellular basis Invasion beyond the submucosa into surrounding structures plus clinical evidence of distant spread are necessary for diagnosis of malignant carcinoid Metastases usually develop by local dissemination through the contiguous mesentery and by the usual hematogenous routes Lymphatic involvement and perineural invasion are also seen

Apparent essential components for the symptom complex

(flushing and "cyanosis," patchy transient skin lesions, diarrhea, dyspnea and right-sided cardiac valvular disease, attributed to excessive serotonin secretion by carcinoid tumors) are a malignant tumor with hepatic metastases, liver destruction and concomitant 5-hydroxytryptophan production, *but the exact mechanism* for production of these symptoms is not clear

The authors' cases showed no symptom complex suggestive of this syndrome Of 16 nonappendical tumors about 44% showed evidence of local or distant spread Appendical carcinoids showed only local spread Distribution of the 26 cases was appendix 10, rectum 7, ileum 3, duodenum 2, colon 2 and stomach 2 In 1, multiple nodules were found in the ileum, jejunum and cecum

Treatment depends largely on tumor site Complete surgical resection is preferable, but a long-term arrest of the disease can be expected with resection of the primary growth *in the presence of irresectable metastases* Apparently, irradiation has no place in treatment

Extramammary Paget's Disease is discussed by Orville F Grimes[3] (Univ of California) Controversy still exists about the exact nature of Paget's disease of the nipple and extramammary sites Some authors consider the disease to be a type of primary malignant tumor peculiar to the skin but others are convinced that, regardless of its location, it always represents a process secondary to underlying primary carcinoma The true pathogenesis of the condition is difficult to clarify because the phenomenon as it affects the skin is usually of long duration by the time diagnosis is established

Paget's disease arising in an extramammary area occurs most often in parts of the body where a generous supply of apocrine glands exists *In almost all the reported cases* the disease was found in the axillae and perianal region This suggests a close relation between primary malignant disease of the apocrine glands and intraepidermal cellular malignant spread The literature, however, contains reports of several cases *in which extramammary Paget's disease* occurred without an underlying malignant process In certain instances it is a distinct possibility that the underlying

(3) Surgery 45 569 574 April 1959

malignant growth was so small it was overlooked entirely

Grimes studied 2 men, aged 55 and 76 The results support the thesis that Paget's disease represents secondary malignant intracutaneous spread from underlying primary carcinoma The primary tumors were mucoid adenocarcinoma of the anal canal and carcinoma of the prostate, respectively In the man aged 55, the lesion was caused entirely by intraepithelial spread of the mucoid adenocarcinoma In the man aged 76, autopsy showed adenocarcinoma of the prostate gland with direct extension into the pelvic soft tissue and invasion of the left ureter, with mild hydronephrosis Metastases were found in the skin and subcutaneous tissue of the anterior abdominal wall, legs, inguinal, mediastinal and supraclavicular nodes and bone marrow In both patients, special stains showed mucoid material in the Paget's cells similar to that which occurred in the underlying carcinoma Paget's disease may represent merely an unusual mode of spread to the skin along established lymphatic pathways

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THE HEAD AND NECK

Cysts of Neck in Infants and Children. Richard Mendez and John Erbes[4] reviewed data on 1,274 patients with masses of the neck, who had been admitted to the Milwaukee Children's Hospital between 1940 and 1955 Enlarged cervical lymph nodes accounted for the masses in 1,154 patients, whereas of the 120 others, 51 had primary cysts, consisting of thyroglossal duct remnants in 24, branchiogenous rests in 17 and cystic hygromas in 10

The thyroglossal duct remnants presented clinically as draining sinuses in 13 instances, as abscesses in 4 and as cysts in 3 Most of these remnants were evident above the thyroid cartilage opposite the hyoid bone Symptoms lasted from 1 day to 6 years Treatment consisted of complete excision, including the central portion of the hyoid bone in 18 patents, incision and drainage in 1 and simple excision in 5 In the last 5, the operator was unable to trace a tract to the

(4) West J Surg 66 66-72 Mar Apr 1958

hyoid bone, but none of these has shown evidence of recurrence

The cervical branchiogenous rests consisted of 9 sinuses and 8 masses, which varied in location from the sternoclavicular area to the angle of the jaw All, however were in the anterior triangle of the neck just anterior to the sternocleidomastoid The rests measured only 1 3 cm in diameter and were small compared with other cervical masses In all but 4 patients, they had been noted since birth and average duration of symptoms was 3 5 years Treatment in all was complete excision

Cystic hygromas constituted the rarest group of primary cysts of the neck They were 2 5 17 cm in diameter and were usually seen in the posterior triangle of the neck In half the patients, the lesion had been noted since birth, and in all but 1, it had been present before age 1 Treatment consisted of complete excision in 7 patients In 2, the lesions were so extensive that only partial excision was possible These 2 patients were the only ones in this group who died In 1 patient, treatment was deferred because of upper respiratory infection

Of the total patients with enlarged cervical lymph nodes in only 11% was the mass the presenting complaint In only 2% of those diagnosed as lymph nodes was a cervical mass a presenting symptom

Sialography in Children With proper sedation, instruments and radiopaque materials, sialography yields good results in children as young as age 18 months, according to Bromley S Freeman[5] (Baylor Univ) Premedication is of paramount importance

TECHNIC —A secobarbital suppository or Phenergan® as suppository or orally has been satisfactory If a tender gland is to be probed meperidine 0 5 mg /lb should be given 30 minutes before the procedure Surface anesthesia with 2% tetracaine hydrochloride is carried out while preliminary posteroanterior and lateral films are taken The finest silver probe is inserted gently into the mouth of the parotid duct and slid forward to the masseter muscle allowing the wider proximal end of the probe to dilate the tiny sphincter Then the special needle attached to a syringe containing Pantopaque® is slipped into place and injection started slowly After about 0 8 1 cc contrast medium has been injected the patient complains of severe pain and the injection is stopped Posteroanterior and lateral films are taken Plates

(5) Surg Gynec & Obst 107 505 507 October 1958

are read wet and if satisfactory, the patient is given a lemon sucker The films are repeated 30 minutes later If retention is noted, the films may be repeated in 24 hours

For entering Wharton's duct magnifying lenses are used The maximum amount of contrast medium injected into the submaxillary gland is 1 cc in children aged up to 6 years In older children injection is regulated by the routine end point of pain To avoid loss of



Fig 15 —Parotid tumor of 2 months duration in girl aged 21 months Sialogram under local shows pooling in necrotic tuberculoma (Courtesy of Freeman B S Surg Gynec & Obst 107 505 507, October 1958)

contrast material constant pressure is maintained over the openings of the ducts, or the catheter is plugged or the needle is left in place

Sialography can be used to aid in diagnosis of any questionable mass around the region of the salivary glands (Fig 15) with little trauma, and occasionally may prevent exploratory surgery

Surgical Parotitis is defined by R K Gilchrist and J R McAndrew[6] (Presbyterian St Luke's Hosp, Chicago) as an acute inflammation of the parotid gland, uni- or bilateral, which occurs most commonly after surgical procedures The complication is rare and unexpected and usually affects the seriously ill, dehydrated, undernourished patient with poor oral hygiene A dry mouth and decreased salivary secretion are the principal precursors to onset of the disease, which is almost always caused by the Staphylococ-

(6) A M A Arch Surg 76 863 867 June 1958

cus aureus organism Onset is usually 4-6 days after operation Occasionally the first symptom is pain in the temporomandibular joint, but more often there is localized pain and swelling in the gland A febrile response occurs within the first 24 hours, with temperatures of 102 103 F, along with acute elevation in the leukocyte count Mortality rates have varied from 30 to 60% in most series reported

The authors observed 7 patients with surgical parotitis All were treated with x rays as an emergency procedure within the first 12 hours after onset of symptoms and immediately on making the diagnosis X-ray dosage was 75 r to the gland tissue daily One patient responded to x ray therapy alone within 48 hours Within 48 72 hours when swelling and pain appeared clinically to be progressing despite x-ray therapy, 6 of the patients were subjected to decompression in the operating room under local 0 5% procaine anesthesia Relief from pain was almost immediate and marked reduction of swelling was noticed within the first 3 4 hours

► [Our experience has been similar to tha ... that *postoperative parotitis is best treated* ... started as soon as the diagnosis is suspecte ... sary —Ed.]

Papillary Cystadenoma Lymphomatosum (Adenolymphoma) Review of Literature is presented by A P Chaudhry and Robert J Gorlin[7] (Univ of Minnesota) A benign neoplastic disease of the major salivary glands the lesion affects chiefly men aged 41 70 and is characterized clinically by a well defined round or ovoid swelling in the parotid gland or periparotid regions The highest incidence is in the 6th decade Histologically, the lesion is composed of epithelial papillary processes projecting into dilated cystic spaces *These processes are supported by lymphoid stroma* containing germinal centers

Papillary cystadenoma lymphomatosum has been reported to comprise 2-6% of all parotid tumors and 1 6-4 2% of all new growths of the salivary glands *Clinically it is* indistinguishable from other benign lesions of the parotid gland The most practical method of diagnosis is microscopic examination of the frozen section at the time of operation The tumor is round or oval and often flattened it is sur

(7) Am J Surg 95 923 931 June 1958

rounded by a thick, strong, glistening capsule. Rarely does it infiltrate the surrounding gland. The surface may be smooth or lobulated and is commonly pinkish gray. It may be soft and fluctuant or firm or both. The cut surface is studded with whitish nodules corresponding to germinal centers.

Microscopically, the essential components of the neoplasm are epithelial parenchyma and lymphoid stroma. The parenchymatous tissue is made up of tubules and dilated cystic spaces, into the lumina of which slender, finger-like papillary processes project, giving the neoplasm its characteristic appearance. In the most typical arrangement, the epithelium which is the lining of these structures is composed of two rows of cells.

Surgical removal is the treatment of choice. Radiation is of no value. The neoplasm is apt to recur if incompletely removed or if present in multicentric foci.

Parotid Tumors: 10- to 15-Year Follow-up on 28 patients who had radical parotidectomy is presented by William B. Hutchinson and Lawrence B. Kiriluk[8] (Seattle). Malignancy was found in 12. Only 1 of the 12 had recurrence, which resulted in death 10 months later. The carcinoma in this patient had been far advanced. Of the 16 patients with mixed tumors, 2 had recurrence 4 and 5 years after surgery. In each, the site of the recurrence was in the skin along the scar of the incision. Thus, the long-term follow-up showed that carcinomas and mixed tumors did not behave very differently. One patient with Warthin's tumor (papillary cyst adenolymphomatosum) was included in the group with mixed tumors because it is believed both tumors should be treated precisely the same. At surgery, there is no way to differentiate accurately between the mixed tumor and Warthin's tumor except histologically. The recurrence rate is higher in Warthin's tumor.

All of the patients showed some temporary facial paralysis postoperatively. That the great auricular nerve is cut in the radical operation should be remembered postoperatively because in some patients a neuroma develops and is often evident to them. They should be reassured that this is not a recurrent tumor. Full-thickness skin flaps are extensive, but assure excellent exposure. Lack of an unsightly scar often

(8) Surgery 44:483-491, September, 1958.

depends on how neatly these flaps heal to the underlying tissue

The Frey syndrome is a possible annoying postoperative sequel, usually appearing within 2 years after surgery and consisting of flushing and/or sweating in the area of the skin flaps developed at the time of surgery The reaction occurs during the meal or shortly afterward

Treatment for parotid tumors should be radical parotidectomy early in the disease Preservation of the 7th nerve is possible in all patients in whom the nerve has not been invaded by the tumor

► [Total parotidectomy does not seem justified in the treatment of lesions other than carcinoma A high recurrence rate of mixed tumor after simple excision is adequately documented but excision of the superficial lobe is attended by a very low incidence of recurrence and a lower incidence of 7th nerve paralysis —Ed]

Salivary Gland Tumors Management and Results in 329 patients admitted to Massachusetts General and Pondville (Walpole) hospitals during 1942 51 are reported by Gerald G Garcelon[9] There were 172 mixed tumors 98 carcinomas and 59 miscellaneous lesions Ten of 17 tumors in the palate were malignant Of 12 patients with mixed tumors in abnormal locations (mostly in oral cavity or upper respiratory tract), 8 were free from recurrence 5 or more years after surgical removal, 2 were lost to follow up and 2 received no treatment Of 20 with carcinoma of salivary gland origin 7 (35%) were living and free from disease 5 years or more after surgery

Of 149 patients with mixed tumor of the parotid gland, 27 (18%) had had one or more previous enucleations Follow up on 69 patients 5 15 years after treatment revealed no recurrence and only 1 had minimal weakness of the mandibular branch of the facial nerve among the 42 subjected to radical excision, with exposure and dissection of the 7th nerve (Adson Ott operation) Partial parotidectomy in 20 patients with small superficial tumors without dissection of the 7th nerve resulted in no recurrence and no facial palsy Of 7 who had simple enucleation of the tumor, 1 had recurrence and 1 complete 7th nerve paralysis The Adson Ott procedure in 13 patients with secondary or recurrent mixed tumors resulted in recurrence in 2 and partial facial palsy in

(9) A M A Arch Surg 78 12 16 January 1959

3 Four had simple excision of the recurrent tumor with three recurrences and two partial facial paralyses

Of 12 (23%) patients with parotid cancer, 5 had one previous excison of a benign mixed tumor, 5 had two previous excisions and 2 had three Of 9 cures among 53 patients with parotid cancer, 8 were in 13 with lesions confined to the parotid, thus permitting radical excision

Total excision of mixed tumors of the submaxillary gland resulted in no disability and no major nerve injury Of 11 patients with mixed tumors of the submaxillary gland, treated by excision of the gland, with or without neck dissections, none had recurrence Three of 6 patients with carcinoma of the submaxillary gland were cured 5 years or more by radical neck dissection, whereas only 1 of 7 who had upper neck dissection was free from disease for the same period One patient with a small, low-grade carcinoma was cured by excision of the submaxillary gland

Enucleation of mixed tumor of the parotid invites possibility of recurrence Radical excision with exposure of the facial nerve should minimize the danger of facial nerve injury and recurrence of mixed tumor, and should be adequate treatment for early carcinoma, which is usually first recognized by the pathologist at operation In more advanced disease total parotidectomy may be necessary, with sacrifice of the facial nerve, combined with radical neck dissection Irradiation with deep x-ray affords palliation for varying periods in about 50% of the patients with advanced cancer of the salivary glands Estrogen alone or combined with irradiation has provided palliation in a few patients

Changing Pattern of Thyroid Disease is evaluated by Thomas J Mudge, Thomas Sellett and Raymond W Nemecek[1] (Augustana Hosp, Chicago) In attempting to determine the incidence of various diseases, the fact that the diseases may not be static but subject to change may be overlooked, e g, in diseases of the thyroid

To determine the frequency of thyroid malignancy, all forms of thyroid disease encountered at surgery during 1935 54 were analyzed The lesions in the 4,542 cases reviewed included nontoxic nodular, toxic nodular, nontoxic diffuse and toxic diffuse goiters, thyroiditis adenomas and

(1) Surgery 43 622 630 April 1958

malignant growths This division is clinical and pathologic in basis and requires a preoperative evaluation of the patient's toxicity followed by the surgeon's and pathologist's description of the gross and microscopic appearance of the gland For clarity and simplification, the nodular and diffuse goiters were charted separately from thyroiditis and the benign and malignant tumors

Early in the study, the incidence of nontoxic nodular goiter was relatively small Since 1946, however, it has been the commonest type of goiter operated on In the last 2 years of study, the incidence of this goiter surpassed all other types combined Conversely, the percentage of toxic nodular goiter decreased fairly consistently throughout the study At present, more patients are seen with toxicity due to Graves' disease than due to degenerating adenomatous tissue

In every year of the 20 year period there was at least 1 case in which the preoperative diagnosis was nontoxic nodular goiter but gross examination revealed diffuse enlargement This enlargement was not the soft elastic swelling of excess colloid seen in the adolescent goiter Instead the gland was firm, with prominent lobulations, and it occurred in patients averaging age 40 4 Microscopically, these enlargements presented a varying picture of hyperplasia, lymphocytic infiltration and increased fibrosis

The incidence of toxic diffuse goiter (Graves' disease exophthalmic goiter, primary hyperthyroidism) declined moderately, but definitely, over the 20 years The reason for the decline cannot be stated unequivocally, but increased iodine consumption may be a factor

There were 131 cases of primary thyroiditis In these, the thyroiditis was the predominant pathologic change in the gland In cases in which lymphocytic infiltration or fibrosis appeared spottily and in small amounts, the term "secondary thyroiditis" might be appended to the main diagnosis on the pathologist's report, but these were not included in the grouping Of the 131, 4 cases were diagnosed as subacute thyroiditis

During the 20 years, 170 benign adenomas were found The criteria included encapsulation, homogeneous structure variation from the structure of the thyroid beyond the capsule

and evidence of compression of adjoining thyroid tissue by the adenoma.

Of 147 surgical cases diagnosed as malignant, 129 were new and 18 recurrent. The commonest histologic types were adenocarcinoma (33.3%), papillary carcinoma (32.6%) and undifferentiated carcinoma (20.9%). The incidence of cancer (suspected and unsuspected in all types of goiter) in the first 10 years of the study was 1.6% and in the second 10 years, 4.2%.

Treatment of Thyrotoxicosis with I^{131}: Review of 500 Cases is presented by G. W. Blomfield, H. Eckert, Monica Fisher, H. Miller, D. S. Munro and G. M. Wilson[2] (Univ. of Sheffield). The criteria for selecting patients was age over 45; younger patients with associated disease, particularly



Fig 16 (left)—Before treatment
Fig 17 (right)—Clinical result of radioiodine therapy, showing shrinkage of gland and improvement of exophthalmos
(Courtesy of Blomfield, G W, et al Brit M J 1 63 74, Jan 10, 1959)

cardiovascular complications; relapse after thyroidectomy; and patients who had not remained euthyroid after antithyroid drugs in whom thyroidectomy had been refused or was contraindicated. Pregnancy is a complete contraindication for irradiation The intended dose to the thyroid was about 7,000 rads in the average case, with a slightly higher dose for patients with severe hyperthyroidism, nodular glands or disabling cardiac complication

(2) Brit M J 1 63 74, Jan 10, 1959

The female to male ratio was almost 4 1, mean age was 50 9 Minimum follow-up was 1 year Of the 500 patients, 80% became euthyroid and 12% permanently hypothyroid, 2% were still hyperthyroid in varying degree, 4% died before final assessment, and 2% could not be traced In all patients with thyroid enlargement, diffuse or nodular, definite shrinkage occurred after treatment, insuring a good cosmetic result even when gross enlargement was present initially (Figs 16 and 17) Improvement in exophthalmos and lid retraction was a common occurrence in most patients The proportion of patients who became euthyroid after a single dose in all clinical groups was 57-60% Among those without palpable abnormality in the thyroid, fewer required a second treatment and more became hypothyroid Of 295 patients who required only a single dose, 227 (77%) became euthyroid within 6 months and 52 (18%) within 12 months Of 104 who required two or more doses, 77 required two, 20 three, 6 four and 1, five doses This last patient previously had been treated by partial thyroidectomy and methyl thiouracil Relapse occurred in 27 after an apparently successful first treatment After further doses, 21 became euthyroid and have remained so, 2 became hypothyroid after a second dose and 4 are still hyperthyroid after recent retreatment None relapsed at a longer interval than 1 year after treatment

Delay of retreatment is important, even in patients with continuing hyperthyroidism, so long as there is any sign of improvement If body weight is rising or steady, the patient will often become euthyroid without further treatment

Restoration of health with a single therapeutic dose of I^{131} was achieved in only 59%, in 41%, reaction to the first dose was inadequate or excessive Hypothyroidism is usually manifest within 6 months, but occasionally appears late So far, the longest interval noted was 5½ years after therapy The highest incidence of hypothyroidism occurred among patients with small glands, the size of which probably had been overestimated The patient's age and wide variations in the uptake and half-life of I^{131} in the thyroid did not have any consistent effect on the clinical result

Patients with tracheal compression or distortion due to thyroid enlargement were treated No symptoms due to tra

cheal compression occurred after therapy, and subsequent shrinkage of the gland restored the tracheal abnormality toward normal Several normal pregnancies have occurred following therapy.

Transformation of Low-Grade Papillary Carcinoma of Thyroid to Anaplastic Carcinoma after Treatment with Radioiodine is reported by George Crile, Jr, and Donald H. Wilson[3] (Cleveland Clinic) It has been shown that in laboratory animals stimulation of the target organs by tropic hormones causes first hyperplasia, then nodular change, then the development of cancers that depend for their growth on the persistence of the imbalance that caused them Finally, if the endocrine imbalance persists, undifferentiated cancers that are autonomous and unresponsive to endocrine control may be produced

In man, it has been suggested that many differentiated cancers of the thyroid are "endocrine dependent" Not only is the growth rate of these cancers increased by any treatment that induces hypothyroidism and increases the output of thyroid-stimulating hormone, but also, just as in animals, prolonged stimulation by thyroid-stimulating hormone may convert a low-grade, differentiated and endocrine-dependent tumor into a highly malignant anaplastic cancer that is no longer dependent on thyroid-stimulating hormone

The authors observed a woman in whom, after a period of myxedema induced by I^{131} treatment, a low-grade papillary carcinoma that had shown no tendency to grow during 34 years was transformed into a highly undifferentiated, rapidly growing, autonomous cancer This is the 14th case of this type to be reported Experimental and clinical evidence suggests that the increased output of thyroid-stimulating hormone induced by the I^{131} treatment initiated the transformation of the cancer to an undifferentiated, autonomous type or promoted the growth of dormant cancer cells

Most tumors that are sufficiently differentiated to take up I^{131} still depend on thyroid-stimulating hormone for continued growth Most such tumors cease growing or shrink after the output of thyroid-stimulating hormone is suppressed by feeding thyroid Because treatment of thyroid cancer by thyroid feeding runs no risk of increasing the

(3) Surg Gynec & Obst 108 357 360 March 1959

growth energy of the cancer, a trial on thyroid should be given before I^{131} is used If I^{131} is to be used, the period of myxedema should be as short as possible

Operable papillary carcinomas should be removed, even if they are not growing because some can undergo change to a more malignant type

Papillary Carcinoma of Thyroid: Evaluation of Surgical Therapy in 62 patients was undertaken by Charles R Underwood, Lauren V Ackerman and Charles Eckert[4] (Washington Univ) The proportion of women to men was over 4 1 The commonest presenting symptom (53%) was that of a single nodule within the thyroid In 39% of the patients lymph node enlargement was a major presenting finding when first seen Pure or predominantly papillary tumors were present in 64% of the patients, whereas 36% had mixed papillary and follicular tumors

Presence of psammoma bodies in a papillary lesion of the thyroid indicates malignancy Frozen section should be used and may be of value in the immediate pathologic diagnosis There was no correlation between minute variations in microscopic pathology and prognosis

Sixteen different types of operations were performed in the 62 patients, which reflects the diversity of surgeons and of concepts of "adequate therapy" Local excisional therapy was often, but not invariably, associated with local persistence

When operating on a lesion of the thyroid gland suspected of being a neoplasm, the entire involved lobe should be resected by extracapsular dissection If the tumor involves the isthmus or the opposite lobe, a wide margin should be taken about the area of extension Should diagnosis of papillary carcinoma be made subtotal resection of the opposite lobe, leaving only a small amount of normal glandular tissue on the posterior capsule, should be performed With palpable lymph node metastases, definitive neck dissection should be done After diagnosis of metastatic papillary carcinoma by excision of a node in the neck, in the absence of a clinically obvious tumor in the thyroid, total lobectomy should be performed on that side and subtotal lobectomy on the contralateral side with en bloc radical neck dissection

(4) Surgery 43 610 621 April 1958

on the side with demonstrable metastases. If during the follow-up it becomes apparent that disease persists in the neck, secondary surgical removal may still control the tumor. This is particularly true when the persistence is in a lymph node rather than in diffuse invasion of the rest of the vital neck structures. Irremovable or metastatic lesions should be treated with thyroid hormone, 180-300 mg./day. X-ray therapy may control the pain from osseous metastases and promote recalcification and healing in pathologic fractures. Radioactive iodine has been of little value in papillary carcinoma.

Papillary Cancer of Thyroid: Review of 25 Years' Experience at Memorial Center for Cancer, New York, is reported by Edgar L. Frazell and Frank W. Foote, Jr.[5] Diagnosis of thyroid carcinoma was confirmed in 725 patients and in 393 (54.2%) the tumors were classified as papillary. About one third of the patients were referred after previous thyroid surgery elsewhere and many had disease that could not be controlled or had been successfully treated. Many required further treatment, and some have become long-term survivors. About 15% were referred after local excision of a regional lymph node metastasis only or, rarely, after biopsy of a distant focus. These patients were classed with patients not previously treated.

During 1930-54, a gradual, progressive effort was made to control surgically papillary thyroid cancer, which is notoriously regarded as low-grade. Conventional 5-year follow-up studies are inadequate to determine the true lethal properties of the disease and response to different treatment methods. Some evidence has accumulated to suggest that long-standing tumors may be expected to accelerate their invasive properties after years or decades of relative quiescence. During the study period, 47 patients died of thyroid cancer and 20 are living with clinical evidence of residual thyroid cancer; 6 died of other causes, with cancer of the thyroid still present.

As measured by 5-year survival, papillary cancer runs a more favorable course in patients under age 40 than in older age groups. Among 244 determinate patients, 126 under age 40 had a 5-year survival of 96 8% and 118 aged 40 or over,

(5) Cancer 11 895 922, Sept Oct, 1958

61% Too much stress had been placed on the relationship of age and prognosis because reactivation and aggressive behavior have been noted in tumors originally diagnosed or treated during the more favorable age period Two patients under age 40 died of thyroid cancer 9 and 13 years after they first came under observation The relatively benign clinical course in most young patients with papillary tumors and the more rapid malignant process in some older patients may represent two extremes of the natural course of the disease Males with papillary thyroid cancer have a less favorable prognosis for 5 year survival than do females, and for this there is no adequate explanation

Though the clinical significance of regional lymph node spread of papillary thyroid cancer has been questioned, it is reasonable to assume that this represents capacity for dissemination and that patients in whom this occurs have less chance for long term survival In terms of 5 year survival patients whose disease was recurrent or residual after previous thyroid surgery fared more poorly than those not previously operated on

This study fails to settle the issue of whether or not routine neck dissection for metastatic papillary cancer will be the deciding factor in ultimate survival of the patient, but systematic removal of such metastatic nodes appears to be a step in the right direction Dogmatic statements concerning superiority of one treatment method over another are unwarranted at this time

A few patients had what was considered inoperable disease on admission, and irradiation only was prescribed Ten of 23 patients survived 5 or more years, 1 is living and asymptomatic 26 years after admission, 9 are known to have died of thyroid cancer after 10 months to 8 years, and 3 were lost to follow-up with disease present

Treatment of Papillary Carcinoma of Thyroid Gland Oliver H Beahrs and Lewis B Woolner[6] (Mayo Clinic and Found) studied data on 136 patients subjected to curative surgical treatment during 1938 47 In the same period, 13 patients with inoperable lesions had only biopsy 1 had palliative lobectomy and gross carcinoma remained in the midline portion of the neck

(6) Surg Gynec & Obst 108 43 48 January 1959

In 47 (31.6%) patients, carcinoma was known or suspected before operation In 22 (16.2%) others, enlarged cervical lymph nodes were noted clinically and no lesion could be palpated in the thyroid gland In 14 patients, operation was performed for supposed exophthalmic goiter, in 1 of these, there was a small nodule suspected of being carcinoma In 53 patients, carcinoma was present in nodular or adenomatous goiters Nine had clinical symptoms of hyperthyroidism and high BMR

In 64 patients, there was metastasis to cervical lymph nodes Treatment in absence of metastasis was lobectomy in 30, double resection (lobectomy on the side of the lesion) in 41 and total thyroidectomy in 1 Patients with enlarged cervical nodes were treated by modified neck dissection, except in 5 instances in which radical neck dissection was carried out No cervical procedure was done for patients who did not have clinically involved cervical nodes or when nodes could not be felt at operation There were no hospital deaths

Of the 136 patients, 133 were followed for 5 years, 129 (97%) were living At 10 years, 109 (87.9%) of 124 patients traced were alive Of 57 patients treated 15 or more years before, 49 were traced, 37 (75.5%) were living Of 19 known deaths, 3 resulted from recurrent thyroid carcinoma in the midportion of the neck, 1 patient also had pulmonary metastasis Two patients with pulmonary metastasis were known to be living 10 years or longer Of 11 who had inoperable lesions, 3 are living 9, 10 and 11 years after biopsy

These results support the belief that radical operation is not always essential in management of papillary carcinoma of the thyroid and that neck dissection is not indicated in the absence of known enlarged cervical nodes

Results of Surgery for Thyroid Cancer in 139 patients, in whom the disease was primarily diagnosed and treated at Johns Hopkins Hospital during 1930 56, were evaluated by James R Jude, Jack McK Zimmerman and Grant E Ward[7] Five- and even 10-year survivals for thyroid cancer of papillary and alveolar histologic types are misleading because of the duration of the natural history of this disease Hence analysis was made of the pathogenesis of recurrence and

(7) A M A Arch Surg 77 757 762 November 1958

death among patients with initially resectable cancer

The recurrence rate of papillary adenocarcinoma was 27.4% in 62 patients with an average follow-up of 7.4 years (median 5.4). The recurrence rate in cervical nodes was 17% and in local thyroid disease, 16%. Some recurrences were in both locations. Distant metastases developed in only 3%. In 34 patients with resectable alveolar adenocarcinoma the recurrence rate was 23.5%, with an average follow-up of 6.3 years (median 5.1). Distant metastases were more common (14.7%) as a source of recurrence than among the papillary group, whereas local thyroid recurrence was the same (14.7%) and local node recurrence was 3%. The number of patients with resectable undifferentiated carcinoma was small (10 of 25 patients) and the recurrence rate was high (50%), locally and in distant metastases.

The chronicity of thyroid cancer is apparent from an average survival of 5 years for 4 patients (of 62 considered adequately treated) who died directly of papillary adenocarcinoma, 7 years for 4 (of 34) who died of alveolar adenocarcinoma and 6 years for 2 who died of undifferentiated carcinoma. Of these 10 patients who died, local recurrence was observed in 7, cervical node recurrence in 1 and distant metastases in 4.

The possible multicentric origin of thyroid cancer and the demonstrated propensity for local gland recurrence are evidence of the need for radical local thyroid gland resection with all pathologic types. Such a procedure might eliminate part or all of the local thyroid recurrences and possibly also prevent secondary metastases from such residual disease.

Primary Chief Cell Hyperplasia of Parathyroid Glands: New Entity in Surgery of Hyperparathyroidism. Oliver Cope, W. Milo Keynes, Sanford I. Roth and Benjamin Castleman[8] (Harvard Med. School) describe a new pathologic entity, characterized by hyperplasia of the chief cells and usually involving all the parathyroid glands. They reviewed data on 200 consecutive patients in whom diagnosis of hyperparathyroidism was made.

The commonest form of anatomic disorder seen in hyperparathyroidism is a benign adenoma in one gland with no

(8) Ann. Surg. 148: 375-388, September, 1958.

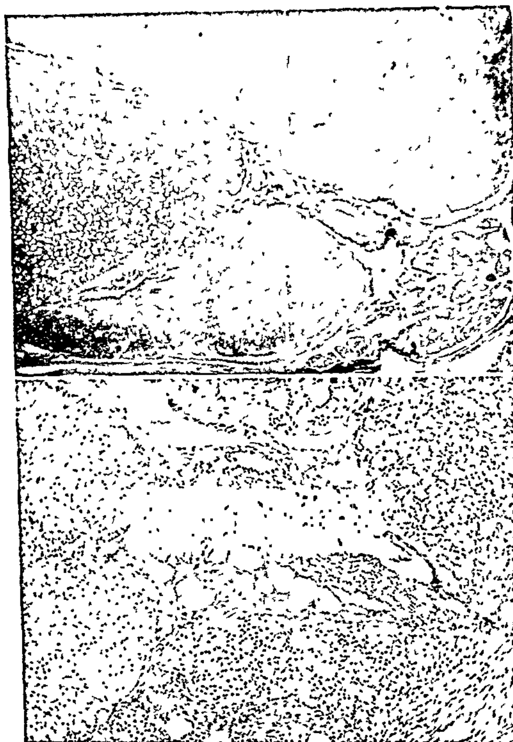


Fig 18 (top) —Primary chief cell hyperplasia in woman, 41 [illegible] lar pattern that often is present, reduced from ×39

Fig 19 (bottom) —Variation of cellular pattern in same [illegible] ×125

(Courtesy of Cope, O, *et al* Ann Surg 148 375 388, [illegible])

disease in the other three Treatment is removal of the affected gland, and it alone Of the 200 patients, 158 (79%) had such single adenomas Occasionally, a double adenoma involving more than one gland was found This occurred in 10 (5%) patients, in 8 (4%) of whom the diagnosis was carcinoma

The new entity, named by the authors "primary chief cell hyperplasia," was found in only 10 (5%) of the patients This entity involves all the glands, and their total weight has varied from 1 to 25 Gm The glands may have a nodular, irregular contour, but, unlike the enlargements seen in water clear cell hyperplasia, pseudopods have not been encountered grossly The glands are tan to reddish-brown, in contrast to the more chocolate-brown color in water clear cell hyperplasia

The microscopic picture is often difficult to distinguish from an adenoma of secondary hyperplasia, except for the fact that the new entity involves all four glands The striking feature in many instances is the great variation in the types of cell within a single gland This is particularly true in glands showing gross nodularity One whole nodule or an island of cells within a nodule may be composed entirely of small, pale chief cells, whereas its contiguous island will be made up of large clear cells of oxyphils (Figs 18 and 19) The predominant cell in most of the glands is a small (6 8 μ) or large (8-10 μ) chief cell, in contrast to the huge (10 40 μ) clear vacuolated cell seen in primary water clear cell hyperplasia The cytoplasm is slightly basophilic in all cells The second commonest cell is the large, pale oxyphil

The clinical picture is one of hyperparathyroidism Treatment is surgical, consisting of total resection of three glands and subtotal resection of one After operation, the blood calcium level falls to normal limits in 24 hours

Surgical Treatment of Hyperparathyroidism is outlined by Frank Glenn[9] (New York Hosp -Cornell Med Center) Primary hyperparathyroidism caused by simple hyperplasia, benign adenoma or carcinoma is accompanied by markedly increased production of parathyroid hormone The excess hormone frees the fixed calcium, thus causing decalcifica

(9) Ann Surg 149 305 320 March 1959



Fig 20 —Osteoporosis of bones of hands and cyst of ulna (Courtesy of Glenn, F Ann Surg 149 305 320 March 1959)

Fig 21 —X ray showing diffuse calcification of superior mesenteric artery and its branches and spleen (Courtesy of Glenn F Ann Surg 149 305 320, March, 1959)

tion of the bones (Fig. 20). Metastatic calcification of the spleen and arteries (Fig. 21) may accompany carcinoma of the parathyroid.

Repeated examination of the thyroid area of the neck before operation, noting any differences on the two sides, may provide a lead as to the location of an adenoma. Esophagrams may be valuable. The slightest distortion of the esophagus may indicate the position of an adenoma.

TECHNIC.—Endotrac [illegible] for hyperparathyroidisn [illegible] and the strap muscles [illegible] gland. Meticulous hemostasis is essential in differentiating between parathy [illegible] pletely [illegible] relatior [illegible] cularity of one area as compared with another area of the thyroid gland may be significant. If a lead is thus gained as to the location of an adenoma, this area should be explored first. If there is no indication, systematic dissection is done, beginning with the isolation and then the division of the vessels supplying the upper pole on the right, being sure that any aberrant blood vessels are identified. The lateral thyroid vein is divided and the lower pole dissected so that it may be retracted laterally and the recurrent laryngeal nerve identified. The right lobe is reflected medially and the right superior parathyroid is located. It is evaluated as to size and appearance, a biopsy specimen is taken and a frozen section done to establish its true identity. The parathyroid of the lower pole is next dealt with similarly. After identifying two parathyroids on one side, the thyroid gland is carefully inspected and palpated in a search for any others that may be present. The carotid sheath is exposed and the carotid artery examined for aberrant branches. If any are present, they are traced to their terminations. Sometimes they lead to a parathyroid adenoma. *After complete examination of the right side, the left is approached* in the same manner.

About 20% of the patients with hyperparathyroidism have more than one tumor; therefore exploration should be complete.

End Results in Combined (Commando) Operation for Mouth Cancer in 58 patients with advanced disease are presented by H. Mason Morfit[1] (Univ. of Colorado). The procedure involves neck dissection combined with intraoral extension (usually jaw resection) designed to remove the primary tumor and regional lymphatics in one stage. Primary tumors originated in the tongue, gum, tonsillar pillar and floor of the mouth, and there were some lip cancers in which

(1) Surg., Gynec. & Obst 108 129 133, February, 1959.

the primary lesion was previously controlled, but metastases to the submaxillary area invaded adjacent bone. The average size of the primary lesion was 10 sq. cm. Many invaded ad-

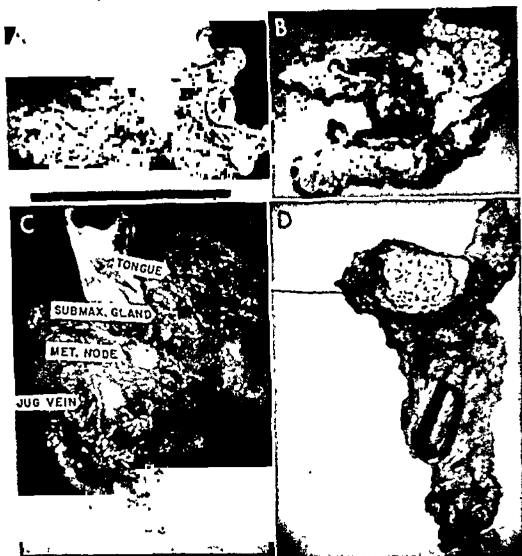


Fig 22.—Representative lesions suitable for treatment by commando operation *A*, cancer starting in gum and invading underlying bony cortex *B*, cancer of anterior floor of mouth invading symphysis menti with bilateral cervical metastases *C*, advanced cancer of tongue spilling over onto adjacent ramus of mandible *D*, exophytic lesion primary in gum invading underlying bone (Courtesy of Morfit, H. M.: Surg, Gynec. & Obst 108 129 133, February, 1959.)

jacent periosteum or true bony cortex (Fig. 22). All were squamous or epidermoid cancers. In only 2 instances during 1948-55 was a patient refused operation because the tumor was too extensive.

Results 3 years after definitive treatment showed 30 failures, including 4 patients who died as the direct result of

operation Recurrent cancer developed within 1 year after surgery in 19 (73%) of the failures: in 5 (19%) during the 2d year, and in only 2 (8%) during the 3d year No recurrence has yet developed in those who remained well for 3 years after treatment The over all salvage rate was 46 6% There was no postoperative death among the last 22 consecutive patients

Routine tracheostomy is now an integral part of the operation, failure to do this accounted for 2 of the early postoperative deaths Fistulas developed in 24% of the patients and healed by secondary intention in every instance Some dysphagia was encountered routinely for a few weeks postoperatively, but all of the patients recovered the ability to eat normally The more posterior the oral defect, the more marked was the swallowing difficulty

Restoration has not been successful in large mandibular defects If the defect is small (1-2 in) and if a reasonably long proximal segment is left, the defect may be bridged later with a graft Unless the symphysis menti is sacrificed, a good cosmetic result can be achieved Most patients have adjusted well to partial loss of the mandible If they have teeth, they are able to chew to some degree If they are edentulous, they have to adjust to a soft, pregound diet In no case has nutrition been a problem

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THE BREAST

Gynecomastia: Origins of Mammary Swelling in Male: Analysis of 406 Patients with Breast Hypertrophy, 525 with Testicular Tumors and 13 with Adrenal Neoplasms is presented by Norman Treves[2] (Mem'l Center for Cancer, New York) Gynecomastia occurred predominantly during puberty and adolescence, with second highest incidence during the male climacteric years The lesion was predominantly *unilateral except when produced by testicular* or adrenal neoplasms The nodes were enlarged in about one third of the patients Location of the mass was usually central (in cancer of the male breast the lesion is usually eccentric) Nipple abnormality was rare Trauma was re-

(2) Cancer 11 1083 110? Nov Dec 1958

called by 14% Endocrine disorders, including general endocrine imbalance and pituitary, thyroid, testicular and prostatic disorders, were present in 24% Breast cancer did not develop in any patients with previously recorded or concomitant diffuse breast hypertrophy

In those with testicular tumors, incidence of gynecomastia was 10% A similar incidence was associated with benign testicular abnormalities When associated with malignant testicular tumors, the gynecomastia was usually bilateral and irreversible (regression did not follow orchiectomy)

Of the 406 patients with breast hypertrophy, 260 were adequately followed Complete clinical regression occurred in 115 (85%) of 136 who were untreated Six who were treated and 21 who were untreated showed no change Of 124 treated with surgery, testosterone or both, 117 (94%) showed satisfactory results Untreated patients were those with mild disease or those expected to recover spontaneously

For some time endocrine imbalance has been considered the dominant cause of gynecomastia Other causal conditions are nutritional deficiencies, use of estrogen or androgen, liver disease and testicular, adrenal or hypophysial tumors Trauma calls attention to, but does not cause, gynecomastia Cancer must be ruled out specifically, through biopsy, when a patient with suspected gynecomastia has an eccentric, firm, localized lesion, nipple discharge or retracted or encrusted nipple

Gynecomastia occurs as a benign lesion that often regresses spontaneously Its importance rests primarily on the fact that it may occur as the result of some other systemic symptom complex, such as endocrine imbalance, liver diseases, testicular abnormalities (including malignant neoplasms), tumors of the adrenal glands or of other glands of internal secretion and many other serious concomitant medical problems Any unexplained gynecomastia, especially bilateral, indicates the need for thorough, and often extensive, diagnostic studies

Florid Papillomatosis of Nipple From the Mayo Clinic files for 1910 56, which contain many thousand mastectomy specimens, both benign and malignant, Francis C. Nichols

cases of florid papillomatosis of the nipple among 310 nipple tumors. Mention is also made of 2 cases seen by Todd and Johns.

The mean age of patients in this series was 45.6, with average duration of symptoms 1.9 years. The chief complaint of most patients (14) was a serosanguineous discharge from the nipple. Nipples, in general, were enlarged, indurated, erythematous and ulcerating (Fig. 23). Before operation most of the lesions were thought to be Paget's disease of the breast. Pathologic diagnosis, before recognition of this en-



Fig. 23. Cut surface of nipple with florid papillomatosis showing presence of slit tumefaction (Centres) (Nichols, F. C., et al.: Surg., Gynec. & Obst. 107: 474-480, Oct., 1958.)

tity, was generally that of low-grade, multicentric, papillary, intraductal carcinoma. Pathologically, florid papillomatosis apparently originates from multiple papillary infoldings of the duct epithelium. Microscopically, it can be distinguished easily from Paget's disease of the breast and from the commoner single-stalked varieties of intraductal papillomas. It is more difficult to distinguish it from low-grade, noninvasive, intraductal papillary carcinoma.

Before the benign nature of this tumor was recognized, various forms of treatment were used. Operations varied from radical mastectomy, with or without postoperative x-ray treatment, to simple excision of the tumor. Seven pa-

tients with diagnoses of multicentric papillomatosis or papillary carcinoma, grade 1, were treated by simple mastectomy. Two of 4 patients who had radical mastectomy were thought to have had low-grade, noninfiltrating, intraductal papillary carcinoma and 2 were believed to have infiltration. X-rays in single or multiple doses were used after simple or radical mastectomy in 3 cases. Benign florid papillomatosis was recognized after biopsy in 2 recent cases. One patient had associated diffuse, chronic, cystic mastitis treated by simple mastectomy; the other patient had local excision of the tumor.

Average follow-up was 9.8 years (0-20), and no patient exhibited recurrence. Five returned at various intervals complaining of painful mastitis in the opposite breast which required simple mastectomy. In no instance was there bilateral florid papillomatosis. Carcinoma developed in 1 patient 12 years later in the opposite breast, for which radical mastectomy was performed. These findings certify the benignancy of this lesion. Local excision is advocated, and long-term follow-up studies justify such treatment.

Endocrine Relationships between Chronic Cystic Mastitis and Cancer of Breast were studied experimentally and clinically by Nathan A. Womack[4] (Univ. of North Carolina). Although treatment of cystic mastitis with progesterone in 15 patients was effective, its expense and the necessity for repeated injections were handicaps. Long-acting testosterone, although an effective antiestrogen, possessed undesirable side effects. Delalutin® was used in 41 patients in a single monthly injection of 250 mg. for 3 or 4 months. The patient was examined every 3 months and if cysts recurred, a new cycle of treatment was begun. All treatment usually could be stopped after the menopause.

Chronic cystic mastitis develops when a factor of initial susceptibility is followed by long and uninterrupted estrogenic action. Chronic cystic mastitis is a conditioned process when not associated with permanent epithelial change. It is thus reversible and this reversion can be brought about by withdrawal of estrogen or use of an estrogen antagonist.

The initiating factor that sets up the potentiality for chronic cystic mastitis is different from that of breast cancer.

(4) Am. Surgeon 24 618-629, September, 1958

The promoting factor, estrogen, is the same In one, estrogen results in a conditioned lesion that disappears with disappearance of the estrogen effect In the other, the estrogen effect is that of epithelial overgrowth, the promoting action in development of cancer that results in cancer progression Since the promoting factor, estrogen, for each is the same, in some women with chronic cystic mastitis breast cancer will develop and in others will not, depending on whether they also possess the initiating factor predisposing to breast cancer In others cancer will develop without chronic cystic mastitis and in some neither Presence of a chronic cystic mastitis will always be tangible evidence of a preponderance of the estrogenic promoting factor and herein lies its significance In breast cancer, withdrawal of endogenous estrogens or use of an antagonist, such as androgens, will be effective only to the extent to which the cancer cells are reversible

Paget's Disease of Breast 20-Year Survey of Cases Presenting at Large General Hospital was carried out by J K McGregor and D D McGregor[5] (Hamilton, Ont) Paget's disease is an uncommon form of breast carcinoma that generally arises in the main excretory ducts of the breast and extends to involve the skin of the nipple and areola The skin lesion is of low-grade malignancy There often is an eczematoid change in the nipple or areola and, for this reason, Paget's disease was originally considered to be an inflammatory lesion The lesion may precede an obvious carcinoma by many years

The authors reviewed data on 21 women with Paget's disease, 3 of whom presented with frank scirrhous carcinoma and 1 had carcinoma of the medullary type The gross features of Paget's disease may vary The most striking characteristic is the eczematoid and usually well-defined superficial ulceration of the nipple and areola Microscopic examination reveals hypertrophy of the epidermis and downgrowth of rete pegs The characteristic histopathologic feature is presence of large, clear, vacuolated cells with small, pyknotic nuclei, known as Paget's cells The authors were impressed by the failure of the pathologic changes to reflect the biologic activities of the underlying tumor It was impossible to speculate as to prognosis or the optimum method

(5) Surgery 45 562 568 April 1959

of management in the individual patient on the basis of the presenting histology

In 10 patients, an eczematoid or ulcerative lesion of the nipple was present for 6 months or longer before diagnosis of breast carcinoma was made. A sensation of itching or burning about the nipple is often the first symptom of Paget's disease. The lesion may present as an erythematous, oozing dermatitis or it may be dry and scaly. There often is copious clear yellow discharge from the nipple. Frequently no mass can be palpated in the breast. When present, it is generally located directly beneath the nipple. Most chronic erosions that involve the nipple epithelium of only one breast are malignant.

Paget's disease of the breast is treated essentially the same as breast carcinoma. Local excision of the nipple is not indicated except as a biopsy procedure. Superficial radiation often improves the skin lesion, but ignores the associated carcinoma. The relative merit of simple or radical mastectomy with or without pre- or postoperative radiation has not been definitely settled. The choice of therapy depends on stage of the tumor, age and general condition of the patient, biologic relation between host and tumor and on radiotherapy.

Carcinoma of Breast in Middletown, USA. Much of the reported experience with carcinoma of the breast has come from larger private clinics and university hospitals where there is unavoidable selection in case material and follow-up is difficult and often incomplete. Therefore, Thomas C. Moore, Donald R. Judd and Will C. Moore[6] record their experience with 307 consecutive cases of histologically verified carcinoma of the female breast, studied from 1935 to 1951, at the Ball Memorial Hospital—the only hospital serving Muncie, Indiana, the well-known "Middletown" of sociologic literature. None of the patients has been lost to follow-up, and all living patients have been followed for a minimum of 6 years.

Carcinoma of the breast accounted for about 10% of the cases of malignant neoplasm seen at the hospital. Patients were aged 22-90, but 71% were 40-70. Only 2 had received previous definitive treatment elsewhere. Carcinoma was noted in the left breast in 160 of the primary cases and in

(6) Surg. Gynec. & Obst. 107: 433-441, October, 1958.

the right breast in 140 Bilateral involvement was noted in 5 patients The Halsted type of radical mastectomy was done in 271 of the 305 primary cases (89%) Simple mastectomy was done in 31 patients and biopsy only in 3 Simple mastectomy was reserved largely for the older patients Two with secondary disease received treatment for local recurrences All patients were operated on by surgical specialists

Of the 307 patients, 110 are living Of the 110, 47 have been followed 10 years or more, 20 have lived over 15 years Death occurred during the first 5 years in 143 (73% of total deaths) Yearly incidence of fatality was relatively constant in the first 5 years, ranging from 21 to 36 and averaging 29 The number of deaths fell rather sharply in the 6th year and this trend continued during the second 5 years after operation, with only 41 deaths (21%) during this period Thirteen patients known to be dead were alive 10 years after operation, they died 11 22 years after operation In 5 of these, death was due to metastatic carcinoma 11, 12, 13, 15 and 20 years after operation Metastatic carcinoma of the breast was the cause of 158 deaths (80%), in 5 (2 5%), death was associated with occurrence of a primary carcinoma elsewhere in the body Other causes, principally cardiovascular or cerebrovascular, accounted for 29 deaths (15%)

Among the 307 patients, 5 year survival was 54% Among 271 managed by radical mastectomy, 5 year survival was 55%, whereas among the smaller group managed by simple mastectomy, it was 45% Presence or absence of axillary nodal metastasis was the most important single factor influencing survival Axillary metastasis was noted in 52% of patients managed by radical mastectomy, 5 year survival in this group was 73% among those without axillary metastasis and only 31% in those with axillary involvement Incidence of axillary metastasis was remarkably constant in the various age groups Length of time devoted to performing radical mastectomy did not appear to be a factor in 5 year survival

In 57 patients, radiation therapy (1 800 2 000 r) was given after radical mastectomy There was no apparent improvement in 5 year survival of patients without axillary metastasis Among 104 with axillary metastasis managed without postoperative irradiation the 5 year survival was 34%,

compared with 53% in 36 patients with axillary involvement who received irradiation. Greater use of postoperative radiation in the 5,500-6,000 r range, especially in patients with axillary metastases, appears to be worthy of more extensive trial and study.

Of 184 consecutive patients followed for 10 years, 33% were alive. Radical mastectomy was done in 164 of the 184, with a 44% 10-year survival in those without axillary metastasis and a 22% survival in those with axillary nodal involvement.

Report of 549 Cases of Breast Cancer in Women 35 Years of Age or Younger, observed during 1937-49, is presented by Norman Treves and Arthur I. Holleb[7] (Mem'l Center for Cancer, New York). If 30 patients are excluded who had adequate surgical treatment elsewhere and showed no clinical evidence of breast cancer on admission, 418 (80%) patients were operable and 101 (20%) inoperable. Over three fourths of the patients reported no familial history of cancer. When cancer was present in the family, the breast was involved in 35%, one-half reporting breast cancer in the mother and almost one-fourth in a sister. There were 445 (82%) married patients and 334 (66%) had been pregnant at least once. The incidence of surgical gynecologic disorders was relatively high for this young age group. In 92%, the patient discovered a breast mass without medical assistance. Tumor was discovered during routine physical examination in only 1%. Nipple discharge was present in 5.5%. Bloody discharge often indicated an infiltrating duct carcinoma with no papillary component. Infiltrating duct carcinoma accounted for 86.6% of the diagnoses.

The minimum 5-year clinical cure rate was 30.7%. When selection was made in terms of operability, this increased to 37.7%. Exclusion of those who died of other causes and those lost to follow-up without evidence of recurrence or who refused treatment yielded a maximum rate of 40.6%. These data and review of the literature indicate that breast cancer in the young woman offers a prognosis equal to that of older women.

When the axillary nodes were involved, the clinical cure rate was lower in younger than in older women. The specific

(7) Surg., Gynec. & Obst 271-283, September, 1958.

location of the tumor within the breast had little or no influence on the results Results of treatment for any specific age below age 35 cannot be predicted (table) on the basis of age alone When axillary nodes were not involved, cancers located in the outer half of the breast had an 8% better cure rate, compared with that for the inner half, midline and central lesions Prognosis was better among those with less common breast cancers, e g, medullary, comedo and colloid carcinoma, than for infiltrating duct carcinoma The incidence of axillary node metastases was likewise lower The higher the level of axillary node involvement, the poorer the prognosis Involvement of level 3, however should not be used as a criterion of inoperability because 16% of these patients were free from recurrent cancer 5 years or more after radical mastectomy

Although pregnancy simultaneous with breast cancer had extremely poor prognosis, pregnancy should not be used as a criterion of inoperability Pregnancy some time after mastectomy for cancer appeared to have little influence on prognosis

Patients who delayed longer than 6 months before surgical treatment showed a higher incidence of axillary node metastases and a lower clinical cure rate than those who sought treatment earlier Postoperative x-ray therapy, regardless of axillary node involvement, had no influence on clinical cure rates Patients classified under clinical failure had a median duration of life slightly over 2 years, over two thirds died by the end of the 3d year When axillary nodes were not involved, prophylactic castration did not affect the cure rates When axillary nodes were involved, the 5-year cure rate was 8 3% higher among patients castrated prophylactically Median duration of survival after therapeutic castration for metastatic breast cancer was 9 months Prophylactic simple mastectomy is not recommended even in presence of a significant family history of breast cancer Tumor size alone was significant prognostically, whether the axillary nodes were involved or free from metastases

The authors suggest that certain stringent criteria of operability be modified Even young women with axillary node metastases at the highest level have a 16% chance for 5-year cure Early diagnosis and prompt radical surgery offer the

best chance for survival When the primary lesion is small and still localized to the breast, maximum probability for 5-year cure exists Tumors occurring in the breast during pregnancy should be diagnosed and treated immediately.

AGE GROUP AND CLINICAL CURE 420 OPERABLE PATIENTS

	Age Group		
	19 25	26-30	31 35
No of patients	19	105	296
Failures	15	59	177
5 year survivals	5	46	119
Clinical cure	21 0%	43 8%	40 2%

► [This is an excellent study of carcinoma of the breast in a large group of young women and presents good evidence that neither age nor pregnancy should be used as the sole criterion for altering proper treatment. —Ed]

Cancer of Breast: Study of Short Survival in Early Cases and of Long Survival in Advanced Cases was undertaken by D W. Smithers[8] (Royal Marsden Hosp , London), in an attempt to test the opposed theories that no treatment affects the predetermined pattern of human breast tumor behavior and that even more drastic treatment is required if its course is to be altered profoundly

Among 2,648 new patients with breast cancer observed during 1937-53, 583 had tumors in stage I and 38 (7%) of these died within 2 years of treatment Tumor grade had been recorded in 19 of them Two with grade 1 inner half tumors had had local removal elsewhere, but in neither were axillary lymph nodes involved Another had disease of multicentric origin producing several tumors and at operation was found to have undetected axillary lymph node involvement Eight tumors were grade 2, 3 of these were inner half and 2 central tumors, 3 tumors were of multicentric origin, 2 with involvement of lymph nodes Two of these patients had histories of less than a month and outer half tumors of 2 cm and 2 3 cm diameter, giving no reason to suspect disaster Liver metastases developed in both One patient had a history of over a year, preoperative irradiation, no axillary lymph node involvement, but extensive local invasion of perivascular and perineural lymphatics, metastases developed in bone and liver Eight patients had tumors in grade 3, 5 had inner half tumors with histories of under 3 months, 3 had no axillary lymph node involvement and 3 had lymph

(8) Am J Roentgenol 80 740 758 November 1958

node metastases with obvious infiltration of axillary fat The preponderance of inner half tumors (11 of 19, with 2 more placed centrally) is striking The dangers of inadequate surgery for diagnosis and of multiplicity of primary tumors are suggested Two of 3 with stage I, grade 1 tumors had had local removal of lumps thought to be innocent, followed by delay of several days in 1 and several weeks in the other before mastectomy was performed All 38 patients with stage I tumors who died within 2 years had distant blood-borne metastases, with a predominance of liver and brain deposits

Of 293 stage IV breast cancer patients seen during 1940-49, 21 survived 3 years or more, 9 were pre- and 12 were postmenopausal by more than 10 years There were no 3-year survivors among patients with stage IV lesions treated within 10 years after the menopause Seven in the premenopausal group had menopause at start of treatment (2 spontaneous, 3 x-ray induced, 1 by oophorectomy and 1 by androgen treatment) Three were still alive 13, 10 and 9 years after (2 with no treatment other than initial roentgen therapy and menopause, and the 1 at 10 years after oophorectomy, adrenalectomy, hypophysectomy, radical mastectomy, testosterone injections and further irradiation) Two of the premenopausal group were treated with estrogens at the time of initial roentgen therapy Eight of 12 older survivors had estrogens, all had roentgen therapy, and 1 had local mastectomy as part of the initial treatment, but nothing other than estrogens later One died 9 years 2 months after treatment at age 84 of cardiac failure The predominant feature in these stage IV cases, particularly in the late postmenopausal group, was the frequency of extensive lymphatic spread compared with that of blood stream dissemination

Smithers concludes that mastectomy is the method of choice in early cases, its extent should be determined on the basis of the individual findings Points favoring a bad prognosis should limit, not extend, use of surgery Large medial tumors with a short history are the only ones in which irradiation before mastectomy is often indicated in stage I, especially when the patient is obese and difficult to examine All patients with inner half tumors and all with outer half tumors with histologic involvement of axillary lymph nodes

should have postoperative irradiation to axillary, supraclavicular and parasternal nodes, especially if the tumor is grade 2 or 3 In all premenopausal women who have grade 3 tumors, multicentric origin, extensive perivascular or perineural lymphatic permeation or involvement of axillary fat, an artificial menopause should be considered as part of the first planned treatment

In some late premenopausal cases, success may be achieved if menopause is induced and energetic irradiation used, especially if spread is by lymphatics In the elderly, estrogen treatment combined with irradiation may also give some long term survivals Adrenalectomy, hypophysectomy and radioactive pituitary implants have all produced dramatic regressions, even with widespread blood stream metastases Time is still required for assessment of their value, which must be weighed against their disadvantages These methods are of immense potential importance

Simple Mastectomy Combined with Radiotherapy in Treatment of Cancer of Breast. Results in 109 Patients (1 man), aged 32-82, are reported by R J Scholtmeyer[9] (The Hague) Four were treated only by irradiation, 105 received combined treatment Postoperative irradiation only was used in 29 patients (2,000 r) in whom carcinoma had not been suspected before operation Others received preirradiation through four fields (210 kv , 12 ma, 0 5 mm Cu and 1 mm Al), 6×250 r/field and 5×250 r postoperatively, i e , a total dose of 2,750 r/field Operation was performed 1 or 2 weeks after completion of preirradiation, after-irradiation was started 7-10 days postoperatively

Five-year follow-up was possible in 74 patients Absolute 3 year survival was 57 8% and absolute 5 year survival was 52 7% Five year survival was less favorable in patients with large tumors, being 30 7% for those with tumors 6 cm and over, 48 4% for those with tumors 4-5 cm and 67 8% for those with tumors 2 3 cm Localization of the tumor seemed to exert no influence on prognosis Five year survival among women without children was lower (43 2%) than among those with 1 or several children (58 8%) Relapse occurred in 20 (18 2%) patients, with local recurrence in 8 and metastatic lesions in 12 Recurrences were treated by

(9) Arch chir neerl 10 350 356 1958

irradiation In this group, 11 patients died 1½ 6 years after operation

Function of the arm on the side of operation was generally excellent, only 3 patients had any difficulty Only 1 showed mild lymphedema of the arm

This series is too small to have much statistical importance, but the favorable results support McWhirter's theory that simple mastectomy combined with radiotherapy is effective in most patients with breast cancer The number of local relapses after simple mastectomy with irradiation is no larger than those after radical surgery

► [Results such as these provide a strong defense against attacks on this method of therapy —Ed]

Late Local Recurrent Carcinoma of Breast Kenneth T Pawlias, Malcolm B Dockerty and F Henry Ellis, Jr[1] (Mayo Clinic and Found) report that of 202 cases of locally recurrent carcinoma of the breast following radical mastectomy, the recurrent lesion developed within 5 years of the time of the primary operation in 157 (78%) and after 5 years in the other 45 (22%) In 10 of the latter cases the recurrent lesions developed more than 10 years after operation The authors' investigation was directed primarily to the group of 45 cases (age range 35 72) There was no evidence of possible influence of early diagnosis, in all the primary tumors had not been detected early Primary tumors were generally not small nor were symptoms of unusually short duration, only 23 patients had clinical symptoms for less than 6 months Tumor distribution with respect to grade (Broders' classification) was about the same as that in breast carcinoma generally About half had axillary metastasis Primary tumors involved the lateral half of the breast in 25 patients the medial half in 12 and in 8 were centrally located Lateral tumors were associated with axillary metastasis in 44%, whereas medial and central tumors showed metastasis in 55% Eight of 20 medial and central tumors and 14 of 25 lateral tumors were fixed to the skin Of 22 patients with axillary metastasis only 13 had some skin fixation About half of all the patients showed clinical evidence of skin fixation by the primary tumor

The commonest form of local recurrence for tumors located laterally, medially or centrally was a skin nodule lo

(1) Ann Surg 148 192 198 August 1958

cated medial to the scar near the sternum. Patients with tumors located centrally or medially accounted for 57% of the parasternal recurrences, 44% of the recurrences in or adjacent to the scar, 30% of lateral and 50% of axillary recurrences. Conversely, patients with primary tumors localized in the lateral half of the breast accounted for 43% of the parasternal recurrences, 56% of the recurrences in or adjacent to the scar, 70% of lateral and 50% of axillary recurrences. Of 6 patients with axillary recurrence all had axillary node involvement at the time of radical mastectomy. Of 10 with recurrences in the lateral thoracic wall, 6 had involvement of axillary nodes at the time of breast amputation. Half of the late recurrences in the skin were associated with simultaneous regional or distant metastasis.

Survival after local recurrence in 24 of the 45 patients was about 2 years and ranged from 3 months to 6 years. Only 3 survived over 2½ years. Average survival after local recurrence at 6 years was the same as for those who had local recurrence at 8, 10, 12, 14 or 16 years. The time of local recurrence and final results associated with such recurrence seem to depend less on duration of the disease, size of lesion and extent of local invasion by the primary lesion than on growth potential and individual factors of resistance. Survival after clinical recurrence is usually poor and bears no relation to the length of the cancer-free period before recurrence.

Prophylactic Castration in Carcinoma of Breast. Max F. Rosenberg and Erich M. Uhlmann[2] (Michael Reese Hosp.) did follow-up studies for at least 5 years on 200 women below age 50. Prophylactic castration was performed in 78 by bilateral oophorectomy or irradiation of the ovaries (with sufficient dose to suppress menstruation permanently) shortly after radical mastectomy and before clinical evidence of distant metastases. Of these, 59% survived more than 5 years, compared with 36% of 122 patients who were not castrated. The castration effect was particularly favorable in the group over age 40, where a survival rate of 68.8% seems to indicate that castration may be of importance during early menopause. Among 66 women who died at a known date within 5 years after mastectomy, survival of the

(2) A.M.A. Arch. Surg. 78:376-379, March 1959.

castrates was longer than that of the women with functioning ovaries.

No practical method to determine the degree of estrogen dependence of breast carcinoma in premenopausal women has been found that could facilitate the indication for castration. Results of this clinical survey, though comprising only 200 women, appear sufficiently significant, even on a statistical basis, to indicate castration by surgical removal or adequate irradiation of the ovaries in all women with ovarian activity as soon as feasible after radical mastectomy. Castration also is suggested to all beyond the menopause who still show signs of estrogen production, as indicated by tests of the vaginal mucosa. An appreciable number of women, even after removal of the ovaries, show evidence of extragonadal estrogen production.

The favorable results in the group aged 40-50 are also suggestive and indicate that suppression of ovarian function may be of considerable importance in the later premenopausal, menopausal and early postmenopausal period. Whether axillary lymph node involvement, emphasized by Smith and Smith as being important, is of great significance appears doubtful.

Prophylactic castration is suggested in all women with breast carcinoma who are still menstruating regularly or otherwise exhibit signs of ovarian activity.

Adrenal-Corticoid Depression of Adrenal Estrogens in Cases of Mammary Cancer. George E. Block, Jack D. McCarthy and A. Burgess Vial[3] (Univ. of Michigan) present a preliminary report on 5 women, aged 27-74, with far-advanced mammary cancer. Base line determinations were made of the urinary estrogen excretion over 24 hours. The patients were given hydrocortisone orally, 100-150 mg./day for at least 30 days. At the end of the 30 days, estrogen excretions were again determined. This determination was repeated at monthly intervals. Subsequent to 1 month of treatment with hydrocortisone and at monthly intervals thereafter, response in the patient's disease process was evaluated.

Of the 5 patients studied, 4 had objective remissions while receiving hydrocortisone. One patient who had pulmonary

(3) A.M.A. Arch. Surg. 78 732-736, May, 1959.

metastases with pleural effusion was markedly benefited and has been asymptomatic for 13 months. This patient had consistently demonstrated malignant cells in the pleural effusion. Besides the pulmonary metastases, she also had a cutaneous lesion at the midsternal region. This lesion acted as a barometer for the efficacy of the steroid treatment in that at levels of 100-150 mg. hydrocortisone/day, the lesion would shrink and become painless. When the dose was decreased to 70 mg./day, the lesion increased in size and became painful. Again, with increasing doses, the lesion regressed.

Remissions were seen without relation to the site of the metastatic disease. Three patients had primarily soft-tissue metastases, 1 had skeletal lesions and 1 pulmonary involvement. The 1 patient who did not benefit from hydrocortisone therapy had massive hepatic involvement.

Remissions ranged from 3 to over 13 months. All patients who received hydrocortisone in excess of 100 mg./day improved subjectively, as demonstrated by renewed vigor, increased appetite or a general sense of well-being. Estrogen excretions fell markedly from pretreatment levels in the 4 patients who had remissions. In 2, total estrogen excretion fell from over 2 μg./day to below the level of sensitivity by bioassay. In the other 2 patients whose estrogen excretion was measured by chromatography before and after treatment, a fall in total estrogen as well as a marked depression in the estrone and estriol fractions was observed.

The 1 patient who did not benefit from hydrocortisone had such a low level of estrogen excretion before treatment that by bioassay methods the excretion was less than the level of sensitivity and by chromatographic means, the excretion was less than 1 μg./day.

Adrenalectomy in Advanced Mammary Cancer was studied by George E. Block, A. Burgess Vial, Jack D. McCarthy, Charles W. Porter and Frederick A. Coller[4] (Univ. of Michigan). Advanced mammary cancer is ultimately a fatal disease. Treatment is one of palliation and not of cure. The nature of adrenalectomy is such that when success is not achieved, the surgeon and patient are not left with a situation that remains in status quo. Instead, they are confronted

(4) Surg., Gynec & Obst. 108 651 668, June, 1959

with induced Addison's disease in the face of an advancing lethal neoplasm In addition, they have invested time, effort, money and pain in a fruitless effort Therefore, the authors recommend adrenalectomy only for patients who fulfill most of the following criteria (1) the tumor does not involve the liver, (2) the patient has had previous remission from oophorectomy, (3) the estrogen excretion is high, (4) the patient is of middle age (preferably in the 50's), and (5) the disease has lasted over 3 years

The stilbestrol stimulation test was of no help in the routine clinical screening of patients The cortisone inhibition tests must be evaluated further No correlation between success or failure of adrenalectomy and the response to administration of andro- or estrogenic substances was found However, response to previous therapeutic castration was an excellent guide in the choice of the patient for adrenalectomy Those who have been therapeutically castrated and who show objective regression of the disease have already demonstrated the hormone-sensitive nature of the tumor If, however, these patients fail to respond to oophorectomy, it is necessary to look further to see if estrogen excretion fell after ablation of the ovaries If this did not occur, castration did little to alter the host's environment and the response to castration cannot be considered as an index of the estrogen dependency of the tumor

Results of Bilateral Adrenalectomy in Management of Incurable Breast Cancer: Report of 155 Cases is presented by A A Fracchia, A I Holleb, J H Farrow, N E Treves H T Randall, J A Finkbeiner and W F Whitmore, Jr[5] (Mem'l Center for Cancer, New York) Various authors have agreed in emphasizing the temporary nature of objective improvement, but reports on frequency, degree and duration of beneficial effects vary considerably (Table 1) No standard criteria for preoperative selection of patients or postoperative assessment of results at uniform time intervals have been followed

Adrenalectomy or oophorectomy combined with adrenalectomy produced valuable palliation for 6 months or longer in 54 (34 8%) of the 155 patients (Table 2) This was evidenced by tumor regression with concomitant symptomatic

(5) Cancer 12 58 68 Jan Feb 1959

relief and prolongation of life Of 14 postoperative deaths, 8 were secondary to the combined operation and 6 to adrenalectomy alone

Of 51 patients who had previous therapeutic surgical castration, 28 showed good response and 8 of the 28 had further remission after adrenalectomy Of 23 who had not responded to oophorectomy, only 3 responded favorably to

TABLE 1—SUMMARY OF PATIENT RESPONSE TO BILATERAL ADRENALECTOMY FOR INCURABLE MAMMARY CARCINOMA

	No patients				
Authors	Total series	No evaluated	Operative mortality*	Objective response	No response
Dao & Huggins	1[illegible]5	100	[illegible]	39	56
Cade	1[illegible]	1[illegible]	8	51	71
Hellström & Franksson	134	134	3	67	5[illegible]
Galante et al	79	75	10	29	36
Pyrah	75	75	8	39	28
Perlia et al	[illegible]	58	9	16	33
Douglas	45	41	3	20	18
Delarue	36	32	5	19	8
Eckert et al	30	28	6	9	13
TOTAL	[illegible]	[illegible]	[illegible]	29[illegible]	321
PERCENTAGE		100	8 4	43 6	48

*Operative mortality group included those who died of operative complications or of cancer within 30 days postoperatively

adrenalectomy. Of 32 patients who failed to respond to testosterone, 8 had objective remission after adrenalectomy Of 23 who showed good response to androgen therapy, 13 had additional remission after adrenalectomy Of 10 who had shown objective improvement to corticosteroids, 5 had further remission with adrenalectomy Of 6 who failed to respond to corticosteroids, 2 showed favorable response to adrenalectomy Of 3 patients whose condition had apparently been aggravated by estrogens, 2 responded favorably to adrenalectomy

At adrenalectomy, metastases to more than one site were present in 118 (76 1%) patients All 8 with brain metastases failed to respond to adrenalectomy Of 41 with pulmonary parenchymal metastases, 7 responded to adrenalectomy and 5 to combined oophorectomy and adrenalectomy Of 40 patients with recurrent pleural effusions, 9 had objective improvement None with hepatomegaly and jaundice or a rapidly enlarging liver were benefited Of 37 with palpable liver metastases, 8 were improved Of 111 with bone metastases, 17 of 61 responded to adrenalectomy and 20 of 50 to the combined operation Of 24 with metastases to bone only, 6 of 17

were improved by adrenalectomy and 4 of 7 by the combined operation Of 22 patients with inflammatory carcinoma, 8 had primary inoperable carcinoma and 14 had recurrent inoperable growths Of 14 who had the combined procedure, 6 responded favorably and of 8 who had adrenalectomy, 1 improved

The authors suggest certain criteria for selection of patients When there is no detectable estrogenic activity, ablative surgery will usually produce an unfavorable response,

TABLE 2—RESULTS OF OPERATION*

Type of op	No pt	Op mort †		Obj resp		No resp	
		No	%	No	%	No	%
Adrenalect	73	6	8 2	20	27 4	47	64 3
Adrenalect oophorect	82	8	9 8	34	41 5	40	50 0
TOTAL	155	14	9 0	54	34 8	87	56 1

*Based on 6 months objective remission
†Operative mortality group included those who died of operative complications or of cancer within 30 days postoperatively

but presence of estrogenic activity does not necessarily imply success Patients who have benefited from testosterone or corticosteroids and from castration are likely to respond favorably to adrenalectomy Improvement is believed to be due to further suppression of estrogenic activity Actively menstruating patients who have responded poorly to castration are likely to respond poorly to adrenalectomy as well Failure to respond to androgens or corticosteroids does not preclude remission with adrenalectomy The estrogen provocative test was dangerous and inaccurate in its predictions

Patients with inflammatory carcinoma, recurrent involvement of breast, soft tissue and skin and bone metastases had the highest percentage of regression, lived the longest and often received the most satisfactory palliation None with hypercalcemia and bone metastases, however, lived over 1 year Patients with visceral metastases had less frequent and shorter lasting remissions, but some did benefit by adrenalectomy Functional disturbance due to visceral metastases indicated a poor prognosis and usually a poor operative risk

Combined oophorectomy and adrenalectomy patients, most of whom were menopausal, had a higher remission rate than those who had previous surgical castration and later adrenalectomy alone. The difference (highly suggestive, but not statistically significant) may be attributed to the added effect produced by simultaneous castration. Hypophysectomy after adrenalectomy seldom proved beneficial and is probably not worthwhile.

Results of Hypophysectomy in Treatment of Metastatic Mammary Carcinoma in 109 patients followed for at least 17 months are reported by Olof H. Pearson and Bronson S. Ray[6] (New York). About 50% obtained objective remissions and 35% had remissions of 6 months or longer (table). The average remission was over 15 months and average survival over 21 months. Objective remissions were obtained in patients of all ages, the range being 28-72 years. The average period between mastectomy and hypophysectomy was longer for patients with remissions (50.4 months) than for those who failed to improve (32.3 months). This suggests that patients with more slowly growing tumors are more likely to respond to hypophysectomy. The overlap in these two groups is so great, however, that this criterion is not reliable in selecting patients for hypophysectomy.

The location of metastases apparently is not important in determining the response to hypophysectomy. Of 16 patients with liver involvement, 7 obtained improvement. Patients with severely impaired liver function and jaundice and with brain metastases were not operated on. Nevertheless, pituitary specimens obtained at operation revealed metastases in 15%.

Of premenopausal patients who obtained temporary remissions from oophorectomy, 85% obtained objective improvement from hypophysectomy, whereas only 50% of such patients obtained remissions from adrenalectomy.

Although a critical correlation between the response to androgen and estrogen therapy and the subsequent response to hypophysectomy could not be made, it appears that the response to these hormones will not prove to be a prognostic guide as to results of hypophysectomy.

Estrogen administration to 5 patients after hypophysec-

(6) Cancer 12:85-92, Jan.-Feb., 1959.

tomy failed to induce exacerbation of tumor growth, thus suggesting that a factor from, or mediated by, the pituitary is necessary for estrogen stimulation of tumor growth. Human growth hormone given to 5 patients after hypophysectomy appeared to induce stimulation of tumor growth in 2. These preliminary observations suggest that growth hormone may be an important endocrine factor in mammary cancer.

Hypophysectomy is recommended as a practical, worthwhile procedure in palliative treatment of patients with metastatic breast cancer when adequate facilities are available

*Hypophysectomy Results**

Results	Patients	%
Operative deaths		
Surgery	5	4.6
Cancer	3	2.7
Remissions, mo		
6 or more	38	34.9
<6	16	14.7
Failures	47	43.1
Total	109	100

*The hypophysectomies were performed between March 1954 and September 1956. Table records patient status as of Feb. 1, 1958.

to carry out this procedure. Whether it yields results superior to those of adrenalectomy or combined oophorectomy and adrenalectomy cannot be answered unequivocally, but certain evidence suggests that it does. Six of 22 patients who underwent hypophysectomy after oophorectomy and adrenalectomy obtained some further improvement.

The only reliable index for predicting a favorable response to hypophysectomy is a favorable response to oophorectomy in the premenopausal patient. Other features have not proved of value in forecasting the result. Thus hypophysectomy is undertaken with only about a 50% expectancy of a favorable response.

Hypophysectomy in Treatment of Breast Cancer was studied by Andrew G. Jessman[7] (Harvard Med. School) in 40 patients.

Technic.—Preoperative cortisone therapy is supplemented with intravenous compound F during operation. Cortisone 200 mg. is given on the day of operation, then decreased until the maintenance dose of 50 mg./day is reached by the 7th postoperative day. Hypophysectomy is carried out under general anesthesia through a right

(7) Ann. Roy. Coll. Surgeons England 24:213-238, April, 1959.

frontal approach. The pituitary stalk is cut immediately above the diaphragm with a sharp knife and is traumatized as little as possible. The gland is removed with extracapsular dissection. In the last half of the series it was possible to remove it intact in two thirds of the patients. Diabetes insipidus developed in all patients in the immediate postoperative period. To avoid the dangers of water intoxication, a complication associated with high fluid intake, large corticoid therapy and simultaneous Pitressin® therapy, the author leaves the diabetes insipidus untreated with antidiuretic hormone but allows unlimited fluid intake for the 1st week. By that time, in most patients the polyuria will have diminished to such an extent that it does not require treatment. If, however, the polyuria is sufficient to interfere with sleep, it can be treated with Pitressin® in the form of Pitressin® snuff or Pitressin® tannate in oil.

All patients require thyroid replacement; 90 mg. thyroid substance/day is given, starting 1 month postoperatively.

Anosmia due to olfactory tract damage was the commonest and most disturbing complication. No serious neurologic complications and no visual disturbances occurred. In evaluating results, only objective remission was counted. This consisted of visible regression of cutaneous disease, x-ray regression of pulmonary or skeletal disease or chemical evidence of healing, as shown by alterations in urine calcium excretion or serum acid phosphatase levels. By excellent results is meant the unequivocal alteration in the natural progress of the disease with healing of metastases. By fair results is meant the obvious halting of the disease with subjective, but not necessarily objective, improvement.

Of the 40 patients, 29 were followed for more than 11 months or to death. There were no operative deaths. Of the 29 patients, 8 (27%) achieved excellent and 11 (38%) fair results. When patients showed no response to hypophysectomy, the survival time was only 2½ months.

Indications that the tumor is still responsive to hormone stimulation and hence will benefit from hypophysectomy may be gained in several ways.

1. Previous response to hormone therapy. Previous improvement from oophorectomy or cortisone therapy is a favorable sign. However, there may be a group of patients who will respond to hypophysectomy but who will have shown no previous response to either of these other maneuvers.

2. Use of stimulation or suppression tests and the simultaneous observation of the urine calcium excretion or the se-

rum acid phosphatase levels A positive response to either test is a strong indication that hypophysectomy will be successful A negative test does not, however, preclude a successful result

Two Rare Breast Tumors Bone forming sarcoma and carcinosarcoma are reported by Patricia M Robb and A MacFarlane[8] (Univ of Edinburgh) in 2 patients

CASE 1—Woman, 67, had a large tumor underlying the left nipple Nipple and skin were not freely mobile over the tumor but there was no fixation to pectoral fascia No enlarged lymph nodes were palpable in the axilla and opposite breast and axilla were normal Chest x ray showed nothing abnormal A year after simple mastectomy involvement of the left axillary and supraclavicular lymph nodes was noted Despite radiotherapy and hormone treatment the disease progressed steadily and bilateral oophorectomy and bilateral adrenalectomy were done 20 months after mastectomy Immediate postoperative progress was satisfactory but several weeks after operation the tumor had not regressed

Two separate and distinct tumors were present One deep in the breast corresponded to the well circumscribed lobulated mass found macroscopically This was a bone forming sarcoma which apparently arose in the stroma of a fibroadenoma with gradual obliteration of most of the ducts and flattening or disappearance of the lining epithelium of the survivors The tumor was partially encapsulated but in some areas the sarcoma infiltrated the surrounding fat

The other tumor a carcinoma was superficial and lateral to the sarcoma infiltrating the fat beneath the nipple and spreading in the subareolar lymphatic plexus In one portion of this tumor was a spindle cell area which was interpreted as becoming so anaplastic as to mimic a sarcoma Nowhere in the boundary zone between the two tumors was there any evidence of one type being transformed into the other

CASE 2—Woman 91 had discharge of brown fluid from the right nipple for 6 months and a lump in the breast for a few months At simple mastectomy axillary lymph nodes did not appear to be involved No radiotherapy was given postoperatively She was living and well 5 years later with no evidence of recurrence or distant metastases The basic histologic pattern of the tumor was that of intracanalicular fibroadenoma The large ducts comprising the tumor had undergone carcinomatous change and were lined by large irregular cells with numerous mitotic figures The fibromatous component of the original fibroadenoma also showed malignant growth characteristic of sarcomatous change Carcinomatous ducts were in general sharply demarcated from this malignant stroma thus supporting a diagnosis of carcinosarcoma

Sarcoma of Mammary Gland was studied by Richard J

(8) J Path & Bact 75 293 298 Apr 1958

Botham, John R McDonald and O Theron Clagett[9] (Mayo Clinic and Found) in 34 patients (1 man) seen during 1907-56 The youngest was age 21 and the oldest, 69 (mean 49 2) Both sides were equally affected Mean duration was 55 05 months A *period of rapid growth, averaging* 4 25 months, was noted in 18 Recent weight loss was noted in 6, only 1 of whom had evidence of metastasis Breast pain was noted in 14 Other signs were nipple retraction in 2, fixation of skin overlying the tumor in 10, change in skin color in 7 and ulceration of overlying skin in 3 Palpable axillary lymph nodes were noted in 10

Primary surgical therapy consisted of local excision in 7, simple mastectomy in 3, simple mastectomy with roentgen therapy in 1, simple mastectomy plus pectoral muscle excision in 2, radical mastectomy in 10, radical mastectomy plus roentgen therapy in 10 and radical mastectomy plus Coley's toxins in 1 Recurrent disease in the breast or anterior thoracic wall was ultimately noted in 13 Evidence of metastatic disease was based entirely on x-rays

The authors conclude that true primary sarcoma of the breast is a distinct clinical and pathologic entity that may contain one or more types of malignant mesenchymal tissue intimately admixed with malignant epithelial tissue Associated palpable involvement of axillary lymphatic vessels is of little significance in determining appropriate surgical therapy or ultimate clinical course True primary sarcoma of the breast rarely, if ever, metastasizes to regional lymph nodes

Primary sarcoma of the breast, although occasionally associated with ulceration, rarely invades the overlying integument, but is capable of metastasizing, primarily via the blood stream, most frequently to the lungs Simple mastectomy, with excision of underlying pectoral musculature, is adequate therapy for sarcoma of the breast not containing a malignant epithelial component Primary sarcoma of the breast *that contains demonstrable carcinoma* in fresh frozen sections should be treated by radical mastectomy Wide local excision, when feasible, is indicated in treatment of recurrent sarcoma of the breast

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(9) Surg Gynec & Obst 107 55 61 July 1958

rum acid phosphatase levels A positive response to either test is a strong indication that hypophysectomy will be successful A negative test does not, however, preclude a successful result

Two Rare Breast Tumors. Bone-forming sarcoma and carcinosarcoma are reported by Patricia M Robb and A Mac Farlane[8] (Univ of Edinburgh) in 2 patients

CASE 1 —Woman, 67, had a large tumor underlying the left nipple Nipple and skin were not freely mobile over the tumor, but there was no fixation to pectoral fascia No enlarged lymph nodes were palpable in the axilla, and opposite breast and axilla were normal Chest x-ray showed nothing abnormal A year after simple mastectomy, involvement of the left axillary and supraclavicular lymph nodes was noted Despite radiotherapy and hormone treatment, the disease progressed steadily and bilateral oophorectomy and bilateral adrenalectomy were done 20 months after mastectomy Immediate postoperative progress was satisfactory, but several weeks after operation the tumor had not regressed

Two separate and distinct tumors were present One, deep in the breast, corresponded to the well-circumscribed lobulated mass found macroscopically This was a bone-forming sarcoma which apparently arose in the stroma of a fibroadenoma, with gradual obliteration of most of the ducts and flattening or disappearance of the lining epithelium of the survivors The tumor was partially encapsulated, but in some areas the sarcoma infiltrated the surrounding fat

The other tumor, a carcinoma, was superficial and lateral to the sarcoma, infiltrating the fat beneath the nipple and spreading in the subareolar lymphatic plexus In one portion of this tumor was a spindle cell area which was interpreted as becoming so anaplastic as to mimic a sarcoma Nowhere in the boundary zone between the two tumors was there any evidence of one type being transformed into the other

CASE 2 —Woman, 91, had discharge of brown fluid from the right nipple for 6 months and a lump in the breast for a few months At simple mastectomy axillary lymph nodes did not appear to be involved No radiotherapy was given postoperatively She was living and well 5 years later, with no evidence of recurrence or distant metastases The basic histologic pattern of the tumor was that of intracanalicular fibroadenoma The large ducts comprising the tumor had undergone carcinomatous change and were lined by large irregular cells with numerous mitotic figures The fibromatous component of the original fibroadenoma also showed malignant growth characteristic of sarcomatous change Carcinomatous ducts were in general sharply demarcated from this malignant stroma, thus supporting a diagnosis of carcinosarcoma

Sarcoma of Mammary Gland was studied by Richard J

(8) J Path & Bact 75 293 298 April, 1958

Botham, John R McDonald and O Theron Clagett[9] (Mayo Clinic and Found) in 34 patients (1 man) seen during 1907-56 The youngest was age 21 and the oldest, 69 (mean 49 2) Both sides were equally affected Mean duration was 55 05 months A period of rapid growth, averaging 4 25 months, was noted in 18 Recent weight loss was noted in 6, only 1 of whom had evidence of metastasis Breast pain was noted in 14 Other signs were nipple retraction in 2, fixation of skin overlying the tumor in 10, change in skin color in 7 and ulceration of overlying skin in 3 Palpable axillary lymph nodes were noted in 10

Primary surgical therapy consisted of local excision in 7, simple mastectomy in 3, simple mastectomy with roentgen therapy in 1, simple mastectomy plus pectoral muscle excision in 2, radical mastectomy in 10, radical mastectomy plus roentgen therapy in 10 and radical mastectomy plus Coley's toxins in 1 Recurrent disease in the breast or anterior thoracic wall was ultimately noted in 13 Evidence of metastatic disease was based entirely on x rays

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(9) Surg Gynec & Obst 107 55 61 July 1958

Problem of Ruptured Diaphragm was studied by Philip E Bernatz, Alfred F Burnside Jr and O Theron Clagett[1] (Mayo Clinic and Found) in 112 surgically treated patients Only 8 ruptures were on the right side Clinical manifestations varied from no symptoms to life endangering problems immediately after injury Automobile accidents were responsible for 78 cases

A high index of suspicion on the part of the physician is the most important factor in diagnosis of ruptured diaphragm The presence of extraneous shadows above the diaphragm, such as gas containing or homogeneous areas, and a shift of the mediastinal structures away from this side is extremely suggestive

The average duration of chronic gastrointestinal and cardiorespiratory complaints was 4½ years in this series This prolonged interval could present real problems as regards financial compensation by insurance companies or responsible parties Resulting atrophy of remnants of the diaphragm sometimes caused technical problems of repair that probably would not have existed shortly after the accident

Management of the patient with a ruptured diaphragm and severe associated injuries needs careful evaluation With simple measures directed at decompression of the gastrointestinal tract and expansion of the lung, the diaphragmatic injury may be handled conservatively and repaired when the patient's condition permits However, decompression may be possible and even the frowned on technic of inserting a trocar into the distended viscera transthoracically may improve the patient sufficiently to permit induction of anesthesia surgical decompression and repair of the diaphragmatic defect The average age in this series was 35, so there is usually the advantage of treating a patient otherwise in good health Severe associated injuries sometimes *militate* against an extremely low mortality, but a ruptured diaphragm itself need not lead to fatal complications

(1) J A M A 168 877 881 Oct 18 1958

Repair was accomplished by the abdominal route in 74 patients, transthoracically in 34 and thoracoabdominally in 3 Four patients (3 6%) died in the immediate postoperative period The phrenic nerve was crushed in 67 earlier patients, but the undesirable effects of this maneuver now are considered to outweigh its possible benefits, and it is no longer done Approach through a thoracic interspace permits accurate freeing of adherent structures and reapproximation of freshened edges of the diaphragm with 2 rows of interrupted nonabsorbable sutures Reinforcement of the suture line with a strip of fascia lata was used to advantage in many cases, but has not been included in recent repairs, results appear to justify its omission If the diaphragm has been torn from the rib cage and time and atrophy have erased previously existing remnants, partial thoracoplasty, elevation of the prerenal fascia, suture of the capsule of the liver to the periphery of the defect or use of a plastic prosthesis, such as Dacron or compressed Ivalon, may be necessary Disruption of the musculature forming the esophageal hiatus, which occurred in 11 cases, requires careful reconstruction In this medial zone, use of a flap of pericardium may be useful in repair

Pectus Excavatum According to Paul C Adkins and Brian Blades[2] (George Washington Univ), patients with more than a slight degree of depression are candidates for surgical correction Surgical intervention is done to prevent or remedy cardiopulmonary difficulties as a result of compression of the mediastinum by the sternal depression Although symptoms may be minimal during childhood, continued compression of the mediastinum during the growth period may result in manifest symptomatology in later years Surgical correction may also be done for cosmetic purposes

Two types of operations are available The first is the relatively simple one by Brown, which consists primarily of excision of the xiphoid cartilage and division of the substernal ligament attaching the undersurface of the sternum to the diaphragm This operation has the advantage of being short and relatively atraumatic but is of value only if performed before age 1, when the chest wall has considerable resilience

(2) Am Surgeon 24 571 575 August 1958

The more radical type of operative correction is best performed between ages 3 and 5

TECHNIC.—A bilateral submammary incision is made, and the skin and subcutaneous fat are reflected upward and downward, superficial to the pectoralis and rectus muscles. The xiphoid is freed, grasped and excised. The mediastinal attachments to the undersurface of the sternum, including the substernal ligament, are then divided. The muscular attachments to the costal margins also may be divided. When the entire undersurface of the depressed portion of the sternum is freed from the mediastinum, over-all evaluation of the extent of the deformity is made. Resections of the costal cartilages adjoining the depressed portion of the sternum are carried out, with removal of a 2-3 cm. segment of each involved cartilage. Splitting the pectoralis major and minor muscle fibers is less traumatic than reflecting the entire muscle, affords adequate exposure of the cartilage and does not interfere with the final cosmetic result. A homologous rib graft is quite satisfactory as a strut to hold the sternum elevated in severe deformities. Before closure of the wound, a soft rubber tissue drain is inserted in the mediastinum and brought out through a stab wound immediately below the incision. A dry dressing is applied and no external traction is used.

Early exercises in the postoperative period to correct faulty posture and overcome muscular tightness are of considerable value.

Myasthenia Gravis: Current Status of Pathogenesis, Clinical Manifestations and Management are evaluated by David Grob[3] on the basis of 300 patients observed at Johns Hopkins Hospital. Myasthenia gravis is characterized by weakness and abnormal fatigability of skeletal muscles, particularly those innervated by the cranial nerves, and usually those of the neck, trunk and extremities. In severe cases, weakness of the muscles of respiration occurs. Smooth and cardiac muscles are not involved. The disease usually becomes generalized, but in a minority (about 20%) it remains localized to the extraocular muscles. Symptoms are commonly ameliorated to variable degree by anticholinesterase compounds. This response serves as the basis for diagnosis and management.

The thymus was examined in 53 patients after thymectomy and in 20 at autopsy. It was abnormal in 83%, being hyperplastic with lymphoid follicle (germinal center) formation in 48%, enlarged, but normal microscopically in 7%, and containing or replaced by thymoma in 29%. In 17%, no abnormality was found. Thymic hyperplasia was more common in females and thymoma in males. Most patients with

(3) J. Chron. Dis. 8:536-566, October, 1958.

thymoma had more severe and rapidly progressive myasthenia and the mortality rate was 70%, compared to 40% for patients without a tumor and 30% for the entire group of patients Of the survivors whose thymic status was determined by operation, 17% had a thymoma, whereas of those who died of the disease 41% had a tumor

Management of myasthenia gravis relies mainly on anticholinesterase compounds, of which the most useful have been neostigmine, pyridostigmin (Mestinon®) and ambenonium Longer acting compounds are too hazardous for general use because of danger of accumulation and overdosage Atropine sulfate was given orally or intramuscularly as needed to prevent or suppress the muscarine like effects of anticholinesterase compounds, such as excessive salivation and sweating nausea, vomiting, abdominal cramps, diarrhea bradycardia and, rarely, hypotension About one third of the patients had a slight increase in strength after oral ephedrine sulfate as an adjuvant and a smaller number had a similar response to potassium chloride

Muscular relaxing agents, particularly curare and Flaxedil®, must be avoided in myasthenic patients during anesthesia Quinine, quinidine and neomycin should also be avoided because they may increase neuromuscular block Morphine must be used with caution Demerol® is usually well tolerated though it is well to begin with half the usual dose Mild sedatives may be used in most patients but those with breathing or swallowing difficulty may have serious trouble if too heavily sedated Procaine and its derivatives should be given with caution Several severely ill patients had dental extraction without untoward effect following local procaine infiltration and 1 had herniorrhaphy performed under local Xylocaine® anesthesia Ether and cyclopropane were well tolerated

The value of irradiation has not been demonstrated, but it is apparently not harmful and may be tried on patients who have not done well on medical management

The general consensus is that in patients with thymoma remission occasionally develops after thymectomy, but most have a poor prognosis, which is seldom altered by operation There is more difference of opinion concerning removal of the gland when tumor is not present

The value of thymectomy has not been conclusively demonstrated and there are no definite criteria that may serve as a guide in the individual patient In a disease in which there is such pronounced tendency toward spontaneous variability, it is difficult to know whether favorable results stem from the therapeutic procedure or represent an unrelated change in the course, an effect of increased encouragement of the patient or a result of exacerbation of the myasthenia, which is sometimes followed by improvement It *is recommended* that operation be performed only in young women who are not doing well on medical management and to limit *the procedure to patients who are going progressively* downhill despite careful medical management and in whom the chance for spontaneous remission appears small

Tumors and Cysts of Mediastinum Ian M Morrison[4] reviewed data on 332 cases, 166 from the Liverpool Regional Thoracic Center (1941-57) and 166 referred to the Tumour Registry of the Society of Thoracic Surgeons (1953 57) by British centers other than Liverpool

The series included 93 cysts and teratoid tumors There were 23 teratomas and 13 dermoids, i e, teratoid tumors in which no endodermal tissues were found Of these 36 lesions 3 were malignant The usual explanation for the occurrence of teratoid tumors in the anterior mediastinum is that they arise from cells derived from branchial remnants Of 9 lymphatic cystic tumors in the series, 2 were unilocular, 3 were multilocular and 4 were lymphangiomas Six occurred on the left and 3 on the right side of the mediastinum, and 1 occurred at the esophageal hiatus There were 13 pericardial cysts, 12 on the right and 1 on the left One cyst on the right side was a pericardial diverticulum Although pericardial cysts are usually regarded as developmental, they are rare in childhood and some authors have suggested that they may be inflammatory Of 6 paraesophageal cysts 4 were associated with vertebral anomalies The occurrence of 5 of these in males tends to confirm the view that the condition is more common in males than in females When the cyst was mid thoracic, the anomalous vertebrae were mainly upper thoracic, when it was upper thoracic, the anomalous vertebrae were mainly lower cervical There were 23 bronchogenic

(4) *Thorax 13 294 307 December 1958*

cysts (13 in males). Age range was 8 months to 67 years. Cough, dyspnea and chest pain were present in 14 cases. The essential unity of endodermal cysts was illustrated by 1 case in which a bronchogenic cyst was removed from the right paratracheal region; after 9 months an enterogenous cyst of the mesentery caused intestinal obstruction. There were 6 cysts (5 in women) in which the lining was columnar epithelium or granulation tissue and the wall was fibrous or collagenous. The cysts were discovered on routine radiography and probably represented the end result of inflammation and hemorrhage occurring in cysts of bronchogenic, dermoid or lymphatic type.

The 101 neurogenic tumors (57 in males) in the series included 33 neurilemmomas, 18 neurofibromas, 5 neurosarcomas, 31 ganglioneuromas, 8 neuroblastomas, 1 sympathicoblastoma, 3 benign paragangliomas, 1 malignant paraganglioma and 1 malignant pheochromocytoma. Twenty-three of the patients were in the age group 0-14; 31 were aged 15-29; 24 were aged 30-49; and 23 were over 50. Of the 16 patients with malignant tumors, 7 were under 15; i.e., 7 of 23 neurogenic tumors in patients under 15 were malignant. Twelve neurogenic tumors had extensions through the intervertebral foramen. In 8 cases this was small and could be removed by the thoracic route with the main tumor; and in 4, a special spinal operation was required. Three tumors were in the anterior mediastinum: a neurofibroma, a neurilemmoma and a malignant pheochromocytoma. Of 98 posterior tumors, 65 were in the superior compartment. Of the 18 patients with neurofibromas, 4 had the cutaneous stigmas of Recklinghausen's disease; 2 others had multiple intrathoracic nerve tumors.

There were 47 true tumors of the thymus—30 benign thymomas, 5 thymic cysts and 12 malignant thymomas. The thymic cysts were not associated with myasthenia. Neither were the malignant thymic tumors accompanied by myasthenia; they usually presented with increasing dyspnea as the tracheal lumen became narrowed. Six of the benign thymomas were associated with myasthenia.

Of 36 thyroid tumors in the Liverpool series, 30 were benign and 6 malignant. Fifteen arose from the left, 17 from the right and 2 from both lobes, and 2 were ectopic in the

chest, unconnected with the thyroid gland in the neck Nineteen of the patients were males Twenty-two benign "adenomas" were removed through a cervical incision, the others required thoracotomy or a combined approach In 2 of the malignant cases, neck incisions with partial removal to relieve dyspnea were used, and in the others, thoracotomy or a combined approach Seven benign and 1 malignant tumor were situated posterior to the trachea and lateral or posterior to the esophagus, 2 were removed by neck incisions 2 by a combined approach and 4 by thoracotomy

The 14 mesenchymal tumors included 1 leiomyoma 4 fibromas (1 posterior and 3 anterior), 2 fibrosarcomas, 1 sarcoma and 1 chondromyxoma There were also 2 hemangiomas 1 in a man, 39, found on routine x-ray study and 1 in a girl 16, who had a cystic hygroma removed from the left side of the neck at age 8 There were 3 lipomas, 2 in contact with the pericardium and 1 in the upper anterior mediastinum

The series included 4 benign lymphomas Three were located at the lung root and were easily removed In the fourth case a large nodular mass surrounded the aorta and other mediastinal structures Biopsy showed normal lymphatic tissue The size of the mass increased radiologically over 3 years, but no clinical deterioration occurred

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THE LUNGS AND PLEURA

Traumatic Rupture of Bronchus Clinical and Experimental Study was carried out by Richard M Peters, William E Loring and William H Sprunt[5] (Univ of North Carolina) in 4 patients In 2, treatment was by lung resection and in 2, the injured bronchus was successfully repaired These patients, plus a review of the literature and some experiments in dogs illustrate the following points In chronic *atelectasis unassociated with infection, pronounced* decrease in flow occurs to the collapsed lung No increase in bronchial arterial collateral occurs If normal 1 5 2 vol % of dissolved oxygen is present, no significant amount of unventilated lung is being perfused while the patient is breathing

(5) Ann Surg 148 871 884 December 1958

100% oxygen Both patients with early bronchial repair have normal oxygen saturations

Arterial blood gas studies in chronic atelectasis showed that 10 20% pulmonary blood flow goes to the unventilated lung as compared with a normal of 45-55% Angiograms illustrate anatomically the decrease in flow calculated from the oxygen saturations In associated infection and development of bronchiectasis and/or chronic suppuration, increased bronchial arterial collateral will be found Such increased bronchial arterial collateral after rupture of a bronchus requires resection of the involved lung because infection has been present

Problems of chronic atelectasis emphasize the importance of early repair, usually resulting in normal function Reports have been made of late stenosis after repair, but these have apparently been less common when wire sutures were used instead of silk In the 2 patients reported here, wire was used with excellent results

Observations on 1 patient led to the hypothesis that the mechanism of injury is not a shearing force, but rupture of the bronchus due to increased intrabronchial pressure Large bronchi burst rather than small ones because the force acting on the bronchial wall at any given intrabronchial pressure is greater in the large bronchi In addition, sudden increase in flow creates turbulence at each bifurcation point, which enhances peripheral resistance and tends further to raise the pressure in large bronchi The rupture site will depend on the exact direction and nature of the compressing force and on the strength of the different areas of the bronchial wall This may account for tears at bifurcations and at the juncture of membranous and cartilaginous portions of the bronchi

Technic for Subtotal Excision of Trachea and Establishment of Sternal Tracheostomy is described by William R Waddell and Bradford Cannon[6] (Harvard Med School)

Technic—The patient is recumbent with the neck extended Skin incisions (Fig 24) are planned to provide for elevation of full thickness crossed skin flaps from the anterior chest wall, which can be used to form a tube to pass through the sternum to be anastomosed to the tracheal stump at any level down to the carina (Figs 25 27) The skin flaps are raised with a layer of subcutaneous fat to insure ade-

(6) Ann Surg 149 1 8 January 1959

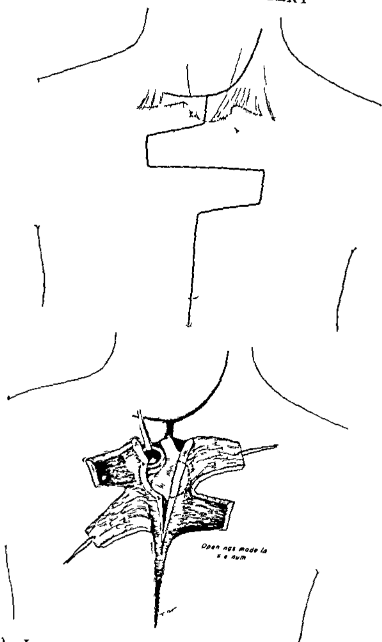


Fig 24 (top) —Incisions for skin flaps exposure of sternum and structures of neck

Fig 25 (bottom) —Hole rongeured in sternum to accommodate skin flaps to be fashioned into tube Tracheal stump is drawn forward and to right of ascending aorta

(Courtesy of Waddell W R, and Cannon B Ann Surg 149 1 8 January 1959)

quate blood supply and are retracted by sutures and protected with moist gauze The neck structures are exposed by standard collar incision with upward extensions on the right or left Various types of upper mediastinal and neck dissections can be carried out, depending on the type of tumor, involvement of organs adjacent to the trachea and presence of metastases

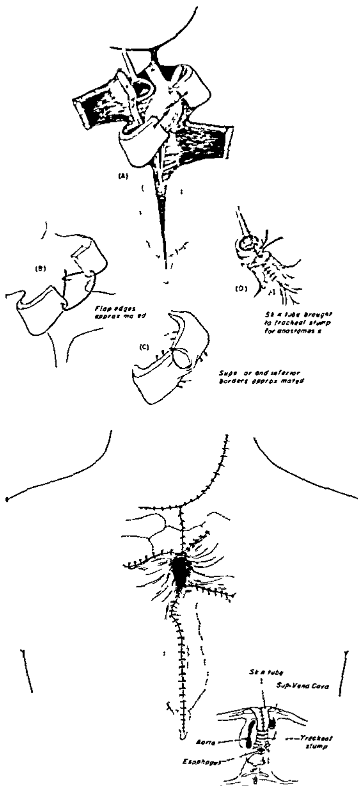


Fig 2 ... A C, method of ... to form tube, *D*, suturing skin tube to t ...

Fig ... l operation showing skin flaps forming ... tinum Inset shows relationship of trache ... as shown in transverse section viewed from above

(Courtesy of Waddell, W R, and Cannon, B: Ann Surg 149 1 8, January, 1959)

The intrathoracic portion of the trachea and surrounding structures are exposed through a midline sternotomy, which is extended down about three fourths of the distance to the xiphoid The left innominate vein is divided, the pleura is pushed away from mediastinal structures by gentle blunt dissection, and inadvertent openings in the pleura are closed Peritracheal lymphatics, the thymus gland and a variable amount of fat can be removed from the level of the aortic arch upward The esophagus can be removed if necessary

After dissection of the involved portion of the trachea, it is transsected at an appropriate level and intubated with a sterile, cuffed endotracheal tube, which is passed across the operative field to the anesthetist For amputation near the carina, a double-lumen tube for insertion into each main stem bronchus may be needed The proximal trachea, larynx and contiguous structures are then removed The pharynx is closed with three layers of fine interrupted silk sutures

Configuration of the aortic arch and the shape of the chest will determine the manner in which the tracheal stump is brought forward Suturing of crossed skin flaps forms a tube that will reach into the mediastinum (Fig 26) Superior and inferior closure of the tube is made with two layers of fine catgut At an appropriate site a hole is rongeured in the sternum to accommodate the skin tube (Fig 25) The end of the skin tube is sutured to the cut end of the trachea with closely placed silk sutures, which engage the tracheal ring adjacent to the anastomosis The cut edges of the sternum are approximated with heavy steel wire sutures Linear closure of skin defects on the anterior chest wall is accomplished by undermining laterally to provide relaxation (Fig 27) Skin grafts may be necessary Complete skin closure is important to prevent sepsis A catheter is brought from the mediastinum through the suprasternal notch and gentle suction applied for 24 hours to evacuate blood and serum After removal of the cuffed endotracheal tube a plastic semirigid endotracheal tube is inserted and except for brief periods, is worn permanently

Simplified Method for Achieving Intrarespiratory Humidification in Tracheotomized Patient is presented by H W Lueders, Allan Stranahan, R D Alley, H W Kausel and A S Peck[7] (Albany, N Y) Isotonic saline was chosen as the most readily available sterile solution satisfying the requirements of humidification It is administered by the usual intravenous tubing with a no 25-gauge needle placed in the lumen of the oxygen-administration tube *about* 6 in from the tracheotomy tube (Fig 28) Isotonic saline flow is regulated with a Hoffman clamp at 4 drops/minute At an oxygen flow rate of 7 L /minute, the oxygen stream vaporizes the saline and disperses the larger droplets into the trachea These droplets migrate into the respiratory tree and vaporize according to temperature of the patient and local

(7) J Thoracic Surg 35 461 463 April 1958

requirements of the lung. A similar drip directly into the tracheotomy tube has the same benefit, i.e., thinning of the secretions, even when oxygen is not concurrently given.

The isotonic saline bottle is marked "For Tracheotomy Tube Use Only," as is the regulating clamp, to avoid confu-

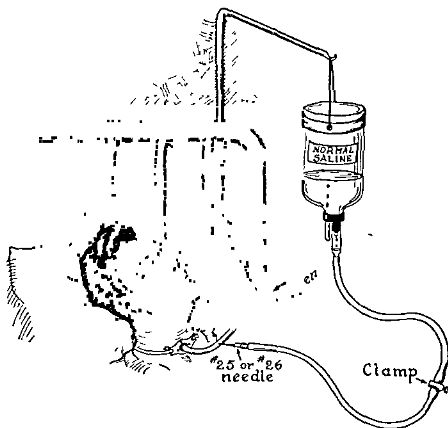


Fig 28—Apparatus for adequate intrabronchial humidification in tracheotomized patient (Courtesy of Lueders, H. W, *et al.*: J. Thoracic Surg 35:461-463, April, 1958)

sion with intravenous solution bottles and thus prevent any possibility of accidentally drowning the patient. The bottle is kept level with the head of the patient to reduce hydrostatic pressure and prevent further possible excessively rapid administration of the isotonic saline solution. Results show that intrabronchial crusts definitely decrease. The conscious patient with a cough reflex can raise sputum with much less difficulty, thereby decreasing the endotracheal suction traumatization and ensuing complications.

Tracheal Fenestration as New Method for Therapeutic Management of Chronic Pulmonary Diseases and for Experimental Exploration of Bronchial Tree is described by

E E Rockey, S A Thompson, I G Epstein, Edward Wasserman and K J Ahn[8] (New York Med College) It is a permanent, skin lined tracheocutaneous communication The external opening of this skin tube is guarded by two doorlike valves which normally are in apposition and prevent leakage of air or liquid These valves may be manually opened and thus provide a short cut entrance to the tracheobronchial tree for aspiration of retained secretion and for medication

TECHNIC —A 4 in transverse incision is made over the anterior aspect of the lower third of the neck The incision is extended so that one skin flap is outlined above and one below the level of the original

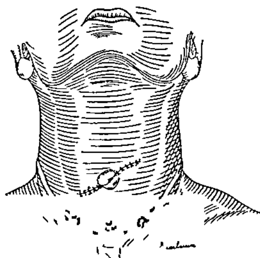


Fig 29 —Completed tracheal fenestration (Courtesy of Rockey E E *et al* Am Rev Tuberc 78 815 821 December 1958)

incision The platysma is incised transversely to about an inch distal to the right and left of the midline The trachea is then exposed by splitting the strap muscles A 1 25 cm length of two adjoining tracheal rings is excised with the underlying mucosa The newly created tracheal window edges are covered by inverting the full thickness of the skin To do this the distal margin of each skin flap is inverted and fixed to the tracheal mucosa with interrupted mattress sutures of silk The distal margin of each opposing skin flap covers two of the four tracheal window edges The left skin flap covers the left and lower margins, and the right flap the right and upper margins (Fig 29) The skin flaps are not dissected from the underlying base but are held doubled by retaining sutures The edges of the flaps are approximated with 000 silk sutures This forms a right and left valve on each side of the tracheal window

Addition of a temporary tracheotomy below the fenestration is of value The tracheotomy is used for the first 2 or 3 weeks allowing

(8) Am Rev Tuberc 78 815 821 December 1958

time for the fenestration to heal When this is accomplished, its clinical function starts, and the tracheotomy below the fenestration is allowed to heal

In contrast to tracheotomy, tracheal fenestration maintains a normal air tract and does not interfere with phonation or the cough mechanism The surgically created tracheocutaneous fistula is always closed, except when the skin valves are held apart Because it is skin lined, its surfaces need not be kept apart by a cannula Experimental use of tracheal fenestration allows exploration of the tracheobronchial tree It can be used to study drug effects on the mucosa or to produce various diseases, including suppuration and neoplasm Easy insertion of a catheter or bronchoscope through the fenestration makes repeated endobronchial medication and observation possible

Clinical indications for tracheal fenestration are advanced emphysema, with or without suppuration, excessive suppurative diseases of the lungs, when excisional surgery is contraindicated, far advanced pulmonary tuberculosis for which no other therapy can be offered, fibrocystic disease of the pancreas, with excessive pulmonary suppuration, and bulbar poliomyelitis, with irreversible changes requiring a mechanical respirator

The operation was performed in 3 patients with advanced pulmonary insufficiency One had far-advanced pulmonary tuberculosis and benefited greatly from the repeated tracheobronchial aspirations and from endotracheal instillation of drugs He died of massive pulmonary hemorrhage 4 months after fenestration A boy, 5½, who had cystic fibrosis of the pancreas with excessive pulmonary suppuration, benefited temporarily from tracheobronchial aspirations and demonstrated that liquefaction of the thick mucus by endotracheal enzyme administration is feasible, but the aid provided by tracheal fenestration came too late, and he died about 6 weeks after operation A patient with advanced emphysema with widespread pulmonary suppuration benefited greatly from repeated tracheobronchial aspirations Cough and tracheobronchial secretion diminished, and he was able to get out of bed and wheel himself around the corridors

► [This is an interesting approach to the problem of patients with chronic pulmonary disease and may prove to be a valuable contribution The results reported by Dr Rockey are sufficiently encouraging to justify further experiment —Ed]

Postpneumonic Pseudo Air Cysts in Children are described by K. Schlager[9] (Vienna). The postpneumonic air cyst is an air-containing cavity in the lung parenchyma, developing in the course of an inflammatory, usually pneumonic, process. It is seen mostly in infants and small children and is characterized by considerable changes in size, *absence of clinical symptoms and spontaneous regression* without therapy. Most authors assume that the primary etiologic factor *is a stenosis of the small bronchi with secondary* cavity formation in the periphery. The cavity may be due either to a poststenotic functional emphysema or to ballooning of small, poststenotic, gangrenous, purulent foci. Both factors probably play a role in the development of the pseudo air cysts. The cysts which occur during resolution of the inflammatory process may be due to emphysema whereas those which occur in the course of pneumonia may be due to abscess formation. The cysts fill with air probably during forced expiration, i.e., during a coughing spell.

A fluid level may be seen occasionally and does not preclude the *diagnosis of pseudo air cyst. Even with* a fluid level, spontaneous regression of the cyst is possible.

The x-ray findings are characteristic but not pathognomonic. There are usually signs of past pneumonia. The cysts have a round or ovoid shape and a thin wall. If the cyst appears larger than the original pneumonic process, its origin cannot be explained by abscess formation. Considerable changes in size of the cyst, especially enlargements during periods of well-being, are characteristic. Large cysts may cause *displacement of neighboring structures.*

Differential diagnosis is difficult. Postpneumonic abscess *formation, partial or tension pneumothorax,* bronchiectasis, congenital cysts, diaphragmatic hernia, tuberculous cavities and perforated echinococcus must be considered.

X-ray diagnosis can generally be made by fluoroscopy and standard films taken in various positions, in combination with spot films. The cysts usually cannot be filled with contrast medium by bronchography. Tapping of the cavity should not be tried in children except in emergency, because of possible complete collapse of the lung, tension pneumothorax *or secondary infection.*

(9) Fortschr. Geb. Röntgenstrahlen 89.136-146, August, 1958.

Cystic Disease of Lungs in Childhood was studied by J. M. Alexander[1] (Royal Alexandra Hosp. for Children, Sydney). A congenital lung cyst may be defined as one arising from some maldevelopment of the bronchi or alveoli. These lesions may be classified as bronchial or alveolar. Each type may or may not communicate with the normal bronchial tree. The cysts may be single or multiple.

Bronchial cysts become manifest clinically if either or both of the following events occur: (1) infection, when they cause symptoms similar to those of bronchiectasis; (2) rapid increase in size, when they cause respiratory distress, severe dyspnea and cyanosis. Examination of the patient in the latter case shows diminished breath sounds and hyperresonance on the affected side, with mediastinal shift to the opposite side. Such cysts are usually confined to one lobe or a portion of one lobe and are shown radiologically as clear air-containing spaces divided by septa into large segments, with the adjacent lobe or lobes compressed. Lobectomy or pneumonectomy is usually required for adequate treatment, but sometimes the primitive bud from which the cyst has developed is so separated from the rest of the lung that the cyst can be removed by ligation of its pedicle. For such a sequence of events to occur there must be a communication with the bronchial tree, and the sudden distention is due to a ball-valve mechanism which is similar to valvular pneumothorax.

As in the case of bronchial cysts, alveolar cysts may be congenital or acquired. In the acquired type, development is due to *bronchiolar obstruction produced by infection*, which permits entry of air during inspiration but prevents its exit during expiration. Consequently, the alveoli distal to the obstruction become distended, with some breakdown and formation of a pseudocyst. The lining of the cysts consists of matted alveolar cells. In the congenital type, maldevelopment of the primitive alveolar bud occurs but at a later stage than in cysts of bronchial origin. Such cysts usually are not present at birth but become distended during postnatal respiration. They are lined with epithelium and may contain mucoid fluid, pus and air or desquamated debris and may or may not communicate with the bronchial tree. If such com-

(1) M. J. Australia 2 676-677, Nov. 9, 1957.

munication is present, especially in the presence of infection increased accumulation of air, with production of tension, may be noted, as in cysts of bronchial origin

► [*Acquired pneumatoceles* occur most commonly in association with or
ularly staphylococcic pneumo-
usual *course is spontaneous*
ociated with maturation and
is the keynote in the surgical
usually require no surgical
treatment and the complications (abscess pneumothorax empyema and bronchopleural *fistula*) are best *treated by aspiration or thoracostomy* tube drainage and appropriate antibiotics It has been repeatedly demonstrated that the conservative approach to acquired pneumatoceles and their complications is associated with a low mortality compared with the high mortality incident to early operative intervention —Ed]

Emergency Pulmonary Resection in Necrotizing Pneumonia is described by Thomas H Hewlett, Leland M Bitner and Patrick Moraca[2] (Brooke Army Hosp) The necessity for drainage of staphylococcic infections throughout the body has not been negated by the development of antimicrobials Effective drainage does not occur in necrotizing pneumonia for several reasons Normal ciliary reflexes of the bronchial mucosa are lost because of widespread destruction in the bronchial wall The gelatinous necrotic debris that collects in the bronchi serves as a mechanical block The accompanying toxemia quickly exhausts the patient so that cough is ineffective A vicious cycle thus develops and tissue destruction continues unabated The impaired circulation to the local area prevents antibiotics from reaching the infected site The futility of medical treatment in such a situation is more apparent when it is realized that in vitro sensitivity of the staphylococcus to specific antibiotics is not proof positive of in vivo response

The authors treated 2 men and 2 women, aged 22-41 by emergency pulmonary resection during the acute phase of necrotizing pneumonia One patient died 2 had uneventful recovery, and reconvalescence in 1 was disturbed by continued postoperative bleeding necessitating a second thoracotomy, and by a bronchopleural fistula The fistula was anticipated after suture of a bronchial stump that showed early necrosis The patient who died would probably have survived if he had thoracotomy when it was first proposed Desperation pneumonectomy in the face of contralateral

(2) J Thorac c Surg 37 580 597 May 1959

disease is not advocated because it offers no promise of significant reduction in the existing mortality rate

Patients who survive staphylococcic lung infection under conservative medical treatment do so only because their response to the infection includes drainage via the tracheobronchial tree or via the pleural cavity A significant percentage of adults who survive the acute stage of the disease require operation to remove crippling bronchiectasis and extensive fibrosis

Pulmonary Abscess· Study of 70 Cases is presented by Daniel N Pickar and William F Ruoff[3] (Univ of Louisville) Pulmonary abscess has long been recognized as one of the most serious diseases of the lungs and before availability of the antimicrobial agents, prognosis was poor, as to morbidity and mortality With advent of the sulfonamides, penicillin and the other antimicrobial agents, and with development of better technics in the field of pulmonary surgery, prognosis for these patients has greatly improved Of the 70 study patients, 44 were treated medically and 26 surgically Twelve (17 1%) died

The authors consider pulmonary abscess to be primarily a medical problem For proper use of antibiotics, the offending organism should be identified at onset of therapy Subsequent studies, preferably at weekly intervals, are needed to detect development of bacterial resistance There were 4 patients whose original cultures grew Friedländer's bacilli These organisms were not sensitive to penicillin In 2 patients, initial cultures revealed a streptococcus and Friedländers bacilli With subsequent cultures, sensitivity determinations and clinical correlation, the Friedländer's bacillus was believed to be the offending organism In 3 patients, hemolytic Staphylococcus aureus was not isolated initially, but was subsequently cultured This organism was resistant to penicillin

Medical therapy was given to the point where no further improvement was considered probable If carcinoma was suspected or if surgical complications existed, surgery was advised earlier Of the 26 patients who had surgery, 19 (73%) had less than 5 weeks of medical therapy Lobectomy was the commonest procedure Of 4 patients who had pneu-

(3) J Thorac Surg 37 452-459 April 1959

monectomy, 3 died during surgery or in the immediate post operative period

In general, the surgically treated patients had a longer period of morbidity than did those treated medically However, the patients requiring surgery were, as a group more seriously afflicted and most had had a course of medical therapy that had proved inadequate

Use of antibiotics and the development of better anesthesia and surgical technics have substantially improved prognosis in pulmonary abscess However, it still remains a serious problem In the authors' series, about 70% of the patients required hospitalization for 1-4 months In 20%, hospitalization exceeded 5 months In 17 1%, the disease ended in death Thus despite medical progress, pulmonary abscess continues to be a prolonged morbid process with substantial mortality rate

Long-Term Results of Resection for Bronchiectasis W H Helm and V C Thompson[4] (London) reviewed results of surgery for bronchiectasis in 159 patients Cure was achieved in 41%, 23% were much improved, 20% were improved, 9% were unchanged and 1% were ultimately worse There were 9 deaths (6%) after operation or during follow up

The chance of complete symptomatic cure following surgical resection depends on whether symptoms arise entirely from the bronchiectatic area and whether the disease is well localized and capable of complete excision Such symptoms as hemoptysis and pain may arise from well localized disease in the absence of severe prolonged infection, and cure usually follows removal of the affected area In the presence of prolonged severe infection, however, although the bronchial dilatation may be well localized and completely removed, the patient's cough and sputum, although reduced, may persist All patients with bronchitis and bronchiectasis were temporarily improved after resection, with less cough sputum and wheezing and better general health but none entirely lost a predisposition to recurrent bronchitis, which often followed upper respiratory infections

Permanent lobar collapse and progressive fibrosis of the remaining lobe occurred in 5 patients after lobectomy, in each, moderate or gross bronchiectasis developed, and only

(4) Quart J Med 27 353 367 July 1958

1 of these patients was improved symptomatically Temporary lobar collapse occurred in 38 patients, but 34 were improved symptomatically by the operation, and deterioration in the bronchographic appearances had occurred in only 5 of the 22 patients so examined

Although great improvement usually follows when efficient medical measures are instituted for bronchiectasis, this treatment must be continued indefinitely, and the improvement cannot be expected to equal that obtained by total removal of the diseased segments Resection, therefore, remains the ideal treatment for bronchiectasis In many patients, however, the outlook with resection is uncertain, since if the diseased segments occupy considerable space and especially if there is any spread of infection to neighboring segments or coexisting generalized bronchitis, deterioration may ultimately follow in the other segments This possibility does not necessarily contraindicate operation, since the patient may remain greatly improved symptomatically, even if new bronchiectasis develops When new bronchiectasis develops after operation, it is usually in segments adjacent to those resected, and such new development is rare in distant segments, especially of the other lung

There is seldom, if ever, any urgent need for operation in bronchiectasis, and in children especially careful assessment should be made Provided medical measures are thoroughly carried out, no harm is likely to be incurred by waiting, and it is often possible to delay bronchograms until they can be carried out under local anesthesia, which is much safer and gives more reliable results than general anesthesia

Pleuropulmonary, Pericardial and Cerebral Complications of Amebiasis Twenty-Year Survey Timothy Takaro (VA Hosp, Oteen, N C) and Walter M Bond[5] (Wanless Hosp, Miraj, India) analyze 7 personal cases with thoracic complications and 286 from the literature Lung abscesses and empyemas were most common, but mixed pathology was noted in 14% and a presuppurative or pneumonic form in 7% Incidence of hematogenous amebiasis and of hepaticobronchial or hepaticopleurobronchial fistula was 7 and 8% Pericardial involvement was present in 22 (7 5%), and 11 (3 5%) had pleuropulmonary and cerebral amebiasis The

(5) Surg Gynec & Obst 107 209 229 September 1958

right lower hemithorax was involved in 75%, the left thorax in 10% and the right upper lung field alone in 3%, in 4% lesions were bilateral Location was not noted in 8% Ninety per cent of the patients were males, and 63% were aged 20-40

Characteristic chocolate sauce or anchovy sauce pus or sputum was seen in only 24%, hemoptysis, blood stained sputum, scanty, mucoid and purulent sputum or no sputum at all being more common Endamoeba histolytica was identified in sputum, pus or tissue sections in 31%, and another 22% showed amebas in the stools or a positive complement fixation test for amebiasis This test is not yet in general use

Emetine no longer occupies its former pre eminent position in treatment of extraintestinal complications of amebiasis Chloroquine was less toxic and apparently as effective Of 242 patients who received emetine, 10% died of the disease, whereas mortality was 5% among 44 patients who received chloroquine Surgery was used in only 26%, with a mortality rate of 33% Open drainage operations were done most commonly Indications for surgery were secondary infection of lung or liver abscess or of empyema, persisting hepaticobronchial fistula, permanently damaged lung, inexpandable lung, drainage or resection of abscess of unknown etiology and failure to respond to conservative treatment

Mortality among the 293 patients, treated or untreated was 19% This represents improvement over the 39% reported in a similar survey 20 years ago but indicates the seriousness of the disease When amebicidal drugs were given, mortality was 10%, when only drugs were used and surgery was not necessary, mortality was 6% Prognosis depends partly on the type of pathologic process Cerebral amebiasis was uniformly fatal, pericardial involvement had a mortality of 55% Hematogenous lung abscesses and those derived from extension from the liver had mortality rates of 45 and 22%, and 29% with mixed pathology died

Surgery should be withheld unless specific indications arise and then should be used only after adequate amebicidal drug therapy Surgery may be avoided in many patients if the underlying hepatic complication is treated before it involves the thorax and before secondary infection occurs Even after thoracic complications, most patients can be suc-

cessfully managed by appropriate conservative nonsurgical measures, provided an accurate diagnosis has been made or a presumptive diagnosis hazarded

► [This excellent review of the subject points up again the serious nature of these complications of amebiasis Particularly significant is the fact that the improvement in the recovery rate that has taken place during the past 2 decades as indicated by a comparison of the current series with our earlier series is largely due to the increased proportion of patients receiving amebicidal drugs in the more recent series This is further reflected by the fact that the mortality rates in the 2 series in which amebicidal drugs were use [illegible] Thus the importance of early intensive [illegible] the application of surgical intervention onl [illegible] when specific indications exist, which was strongly emphasized by our own early experience, is here re emphasized —Ed]

Respiratory and Cardiovascular Phenomena Associated with Pulmonary Embolism Richard K McEvoy, R Allan Harder and W Andrew Dale[6] (Univ of Rochester) conducted experiments on anesthetized dogs, with starch, glass beads or lead phosphate-agar gel as pulmonary emboli By injection of starch or other material through a catheter lying in the superior vena cava just outside the right atrium, general distribution of particles was obtained in both lungs Immediate pulmonary arterial pressure increase, aortic pressure decrease and vena caval pressure increase occurred A return toward control levels of pressure occurred soon, with return to about control levels at 20 minutes Repetition of such doses of emboli produced the same response but with failure of return to control levels after further embolization so that a stepwise change occurred No qualitative difference was noted in the pattern of the phenomena after the small starch or larger glass bead embolism

Neither bilateral cervicothoracic sympathectomy, bilateral cervical vagotomy nor papaverine or atropine intravenously appeared to influence the pattern of response or appreciably change the lethal dose of graded starch pulmonary embolism This observation furnishes arguments against the importance of reflexes mediated via the sympathetic or parasympathetic nervous system in these experiments In each instance of the total series, cardiovascular response appeared to be one of increasing pulmonary hypertension and systemic hypotension The heart appeared to be able to compensate for increased pulmonary resistance up

(6) Surg Gynec & Obst 106 271 287 March 1958

to a given point, beyond which rapid failure and death occurred

There are also certain data which at least indirectly rule against important reflex effects of embolism Failure to change pattern or lethal doses by drugs or autonomic surgery tends to rule against sympathetic or parasympathetic reflexes Graded lowering of lethal dosage by reduction of pulmonary arterial bed appears to indicate that the lethal dose is occasioned by mechanical blockade of the pulmonary arterial system Finally, failure to find evidence of pulmonary arterial vasoconstriction after localized embolism or during lobar perfusion experiments indicates that starch in anesthetized dogs fails to produce important reflex effects

All the pressure records show the same pattern of increasing pulmonary hypertension, slower systemic hypotension and final venous hypertension that has been previously reported This observation leads to the conclusion that right heart failure occurs as the teminal event and is due to pulmonary hypertension occasioned by mechanical blockage of capillaries and arterioles

Pulmonary Infiltration and Fibrosis of Unknown Etiology: Risk of Developing Active Pulmonary Tuberculosis The risk of development of active pulmonary tuberculosis in persons with pulmonary lesions proved by clinical study to be stable or inactive was studied by John F Chace, S David Rockoff and Louis P Hellman[7] (Navy Dept, Washington, D C) in 268 sailors and marines who were hospitalized and returned to duty in 1951 with a diagnosis of pulmonary infiltration or fibrosis of unknown etiology The group was followed from 1952 through 1954 Review of the x rays of the study group revealed localized pulmonary lesions that contained little or no calcification In general, no radiologic difference could be seen between lesions diagnosed as "fibrosis, pulmonary, cause undetermined" and those diagnosed as "infiltration, pulmonary, cause undetermined" Active pulmonary tuberculosis developed in 16 A control group of 493 sailors and marines who were hospitalized and returned to duty in 1951 with a diagnosis of hemorrhoids was also followed from 1952 through 1954 In none of

(7) A M A Arch Int Med 102 367 374, September 1958

those followed did active pulmonary tuberculosis develop

No member of the study or control groups had had active tuberculosis Both groups were analyzed by the actuarial method Comparison of the results indicated that risk of active pulmonary tuberculosis developing is markedly greater in patients with stable or inactive predominantly noncalcified pulmonary lesions than in comparable controls with hemorrhoids Application of the tuberculosis attack rate of the study group to the US Navy as a whole during the years of the study shows the observed number of cases of active pulmonary tuberculosis (1,206) to be less than 2% of the number expected (66,590)

Where development of tuberculosis in the study group was compared with relapse rate in selected US Army patients with active pulmonary tuberculosis who had been treated to the arrested stage and returned to duty, it was found, in general, to be not very different

► [This study is of interest in that such a small percentage of patients with pulmonary fibrosis of unknown etiology were subsequently found to have tuberculosis rather than that more of these patients were subsequently proved to have this disease than in a control group It is well known that the roentgen interpretation of pulmonary infiltrates cannot classify all such lesions etiologically, and it is highly probable that the patients who subsequently developed tuberculosis in actuality had tuberculosis at the time the abnormal roentgenogram was observed —Ed]

Treatment of Tuberculosis Today. Albert R Allen[8] (Central Washington Tuberculosis Hosp, Selah) summarizes treatment results in over 500 patients of all age groups with all types of tuberculosis—primary, reinfection, pulmonary and extrapulmonary No patient had had previous antituberculous therapy All received streptomycin, PAS and isoniazid, with early surgery when indicated Streptomycin was given intramuscularly twice weekly, 1 Gm for adults and 0 5 Gm for children, PAS was given in doses of 10 Gm daily by mouth and was reduced according to weight in children, and isoniazid, 4 mg/kg body weight, was given orally in 3 divided doses Collapse therapy was not used The regimen included modified bed rest The patients were hospitalized for an average of 212 days Medical treatment was given to 188 patients, and 142 had surgery Minimum follow up was over 2 years

The three drug combination resulted in negative sputum

(8) Am J Med 25 75 88 July 1958

and gastric cultures in 84% of all patients by the end of 4 months In those in whom cultures remained positive, antibiotic-resistant organisms developed

Resectional surgery is indicated for the following reasons (1) to convert to negative cultures positive after 3 months of drug therapy, (2) to remove the types of infected tissues which are likely to cause reactivation of disease or have already done so, namely, caseous lesions 2 cm or over in diameter, cavity and advanced bronchial disease, including stenosis, bronchiectasis and tuberculous bronchitis, and (3) to restore pulmonary function by decortication after extensive pleural change from pneumothorax or pleural effusion

Tubercle bacilli resistant to a major drug (streptomycin or isoniazid) are found in patients on their first hospitalization even though they have never received the drug and could not have contracted the disease from someone who had received it Patients with persistently positive cultures for 6 months or over show organisms resistant to the major drugs and when resection is done, have a high incidence of complications, including bronchopleural fistulas, positive cultures and reactivation after discharge

Though drug therapy may convert gastric and sputum cultures to negative, the infected lesion is not necessarily sterilized because in many patients a positive smear or culture is obtained from the resected specimen, or the disease is reactivated later Reactivation is due to presence of virulent, viable tubercle bacilli in certain types of infected tissue into which the drugs cannot penetrate, and it is the physician's responsibility to rule out presence of such tissue or to remove it

Extent of disease is a factor in reactivation because the more extensive it is, the greater the likelihood of presence of serious pathologic change Thus patients with minimal disease respond well to drugs only, whereas surgical patients do better than those medical patients with moderately and far advanced disease because the source of reactivation has been removed With routine anteroposterior tomographs and right angle and foreoblique telescopes for use in bronchoscopy, it is possible to demonstrate most types of tissue involvement likely to cause reactivation

Caseous disease is the most common pathologic change in patients in whom reactivation occurs and is as dangerous a lesion as open cavitation when it has a bronchial connection that is manifest by positive cultures before drug therapy Endobronchial disease is the next most common pathologic change in these patients This applies to both tuberculous bronchitis and bronchial stenosis of the segmental bronchi

The purpose of follow-up is detection of reactivation before progression occurs Gastric cultures should be obtained about 6 months after combined drug therapy is stopped Patients may have positive gastric cultures for a year or over before they show x ray evidence of new disease or will admit to bringing up sputum

While certain groups of patients have a higher incidence of toxic reactions to the various drugs (e g , PAS reactions in those with emphysema, streptomycin and dihydrostreptomycin reactions in those with renal tuberculosis and isoniazid reactions in those with epilepsy), these reactions can and do occur in other patients, even in children They may be serious and can be fatal if not recognized All but toxic nephritis from dihydrostreptomycin occur within the first 50 days of treatment

The program instituted reduced the mean period of hospitalization to 139 days and eliminated the need of occupational therapy and rehabilitation because the patient is returned to his former occupation on discharge, regardless of the physical activity involved in the work About 3% of all patients died of tuberculosis, chiefly children aged 5 or under, with tuberculous meningitis Another 3%, mainly aged 55 or over, died during hospitalization of associated disease About 2% remained chronically ill Thus, satisfactory results were obtained in 92% of all patients with proved tuberculosis

Drug treatment of nonhospitalized patients with tuberculosis falls far short in every respect of what can be achieved with immediate hospital care

Pulmonary Resection in Treatment of Tuberculosis Experience with 1,730 Patients is reported by Raymond J Barrett, Hunter S Neal, J C Day, Paul T Chapman, Paul V O'Rourke, E J O'Brien and William M Tuttle[9] (Wayne

(9) J Thoracic Surg 36 803 817 December 1958

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State Univ) The current status is known in 91 4% Detailed analysis was made of the last 1,528 patients on whom 1,567 operations were performed 100 pneumonectomies, 787 lobectomies, 579 segmental resections and 101 wedge or local excisions There were 35 bilateral resections and 10 patients had second resections on the same side Operative mortality was 2 9% and late mortality 1 9%, a total mortality from all causes of 4 8% There is still active disease in 3 8% Incidence of bronchopleural fistula was 6 2% Relapse occurred in 83 patients, a total incidence of 5% Four (4 8%) died and 62% still have active disease

The unequivocal indication for use of surgical excision was persistence of positive sputum after adequate trial of chemotherapy The highest complication and mortality rate occurred in this group of patients in whom surgery was most urgently needed, regardless of the type of resectional procedure used Among the 18% of patients who had positive sputum immediately before operation, the mortality rate was 13% and 13% relapsed Among those with positive sputum half the operative deaths of the entire series occurred half the relapses, a third of the bronchopleural fistulas and two thirds of the spreads In view of almost certain failure of treatment and grave prognosis in this group without surgery, these higher morbidity and mortality rates are not excessive and must be accepted Every possible effort should be made to remove the major residual lesion Control of remaining widely scattered areas of disease must then be entrusted to the most effective drug

Resection for pulmonary tuberculosis has become increasingly safe in conjunction with adequate preliminary treatment with antituberculosis drugs In a broad central area where indications are unequivocal, use of resection is demanded Its value as insurance against relapse is such that prophylactic resection must be seriously considered even for small residual lesions A positive, even aggressive approach in extensive disease with otherwise grave prognosis is indicated if undertaken with due regard to limitations imposed by lowered pulmonary function, emphysema and advanced age During the past year, 297 resections were performed with total mortality of only 1 3% or less than half the rate for the entire series

Surgical Treatment of Pulmonary Tuberculosis in Mentally Ill: Five-Year Study of 403 Resections is presented by Albert Mowlem, Coleman J Connolly and Bernard Zimmermann[1] (Anoka, Minn, State Hosp) Among the 338 patients there were 289 segmental resections, 67 lobectomies, 23 pneumonectomies and 24 wedge resections carried out in unilateral, staged bilateral and bilateral simultaneous procedures, with an over all operative mortality rate of 8 2% and a patient mortality rate of 9 7%

Of 89 serious postoperative complications, 71 resulted directly from the pulmonary resections Bronchopleural fistula with empyema, empyema alone, bacteriologic recurrence and spread of disease accounted for about two thirds of the complications The other third consisted of pneumonitis, incomplete lung expansion, occult bronchopleural fistula and atelectasis in decreasing proportion There were 15 deaths due to postoperative complications directly related to surgery Most complications appeared to rise in patients in whom the residual lung after resection did not initially fill the chest cavity Treatment for 38 complications of incomplete lung expansion, empyema, empyema with bronchopleural fistula and occult bronchopleural fistula was catheter drainage alone or obliteration of the space by appropriate thoracoplasty

Of all patients operated on, 10 showed late recurrence of pulmonary tuberculosis These patients were previously considered inactive, as judged from x rays and negative gastric washings, but later showed positive gastric cultures Of 71 patients with complications specifically related to the pulmonary resections, 51 recovered after treatment and 5 were still being treated

The necessity for operating on some patients in a group such as this on the basis of radiologic findings alone is demonstrated by the finding of active disease in resected specimens in patients who had never had positive gastric cultures preoperatively

► [Whereas in previous years the indications for surgical treatment of pulmonary tuberculosis in the mentally ill were quite different from those in patients with normal mentality at present the application of surgical therapy for this disease should be the same in the two groups of patients In recent years this policy has been applied in the management of a group

(1) Surgery 43 913 97̶5 June 1958

additional collapse In addition to the larger volume of resected lung, these patients were usually left with raw segmental surfaces They had therefore the two chief predisposing factors to space problems Despite this fact, this complication developed in only 2 patients, an incidence of 6%

Clinical Significance of Cor Pulmonale in Reduction of Cardiopulmonary Reserve Following Extensive Pulmonary Resection. Robert W Harrison, William E Adams, Edwin T Long, Benjamin Burrows and Arthur Reimann[4] (Univ of Chicago) performed physiologic studies on 29 patients 3 weeks to 15½ years after pneumonectomy or extensive bilateral pulmonary resection Results of the studies were compared with the functional capacity of each individual The older the patient at pneumonectomy, the more likely was reduction of functional capacity later

There appeared to be a correlation between functional capacity and abnormalities in maximum breathing capacity, residual volume and maximum midexpiratory flow and inverse correlation between functional capacity and increase in residual volume In patients with increasing amounts of functional impairment, the maximum breathing capacity and maximum midexpiratory flow values became progressively more reduced, whereas residual volume became greater This observation supports the impression that in these patients emphysematous changes were present in the remaining lung as represented by marked overdistention increased airway resistance and arterial oxygen unsaturation and abnormalities in the alveolar gas mixing (abnormal nitrogen washout curves)

Comparison of functional capacity with pulmonary artery pressures at rest and during moderate exercise suggested a direct relationship As functional incapacity increased levels of pulmonary artery pressure at rest and during exercise were more elevated Reduction of functional capacity appeared to be more closely related to effects of pulmonary hypertension than alterations in arterial oxygen saturation

Pulmonary artery pressure pulmonary blood flow relationships in the remaining lung after pneumonectomy differed from those of a normal lung and suggested limitation in expansibility of the vascular bed

(4) J Thoracic Surg 36 352 368 September 1958

When the findings in patients with bilateral resection are compared with those in postpneumonectomy patients, it is impossible to conclude whether removal of a comparable volume of lung tissue bilaterally is better tolerated than pneumonectomy Possibly, some of the adverse effects after pneumonectomy may be attributed to deviation of mediastinal structures and thereby to impairment of ventilatory and cardiocirculatory function Mediastinal shift was absent in patients after extensive bilateral resection

► [The significance of distention of the lung following pneumonectomy or extensive bilateral pulmonary resection is still a debatable point It has been maintained that on the one hand, with the passage of time overdistention results in impairment of pulmonary function, while on the other changes in pulmonary function which occur with time are the result of aging and are inherent in the patient s own pulmonary tree, rather than being a direct result of overdistention Such well controlled and well documented studies as these will help elucidate this problem —Ed]

Effect of Severe Unilateral Hypoxia on Partition of Pulmonary Blood Flow in Man was studied by A Himmelstein, P Harris, H W Fritts, Jr , and A Cournand[5] (Columbia Univ) When a moderate degree of hypoxia is induced in either animals or human beings, elevation of pulmonary arterial pressure often occurs This pressor response appears to be caused by pulmonary vasoconstriction as left atrial pressure is not altered and cardiac output only moderately increased

Such observations have suggested that local hypoxia may play a role in controlling distribution of pulmonary blood flow Local reduction in alveolar oxygen tension would constrict the vessels in the affected area, thereby diverting a portion of the blood carried by these channels through vessels in better aerated parts of the lungs Several investigators tested this hypothesis by inducing unilateral hypoxia Although it was shown that this stimulus can change the partition of the pulmonary blood flow in animals, evidence that this response can be elicited in man was conflicting

In previous experiments, administration of 10% oxygen to one lung in 6 human beings had no observable effect on partition of the pulmonary blood flow The present study was made to investigate the effects of more severe hypoxia by administering 5% oxygen to one lung in 5 normal persons The fraction of the total flow perfusing the hypoxic lung was

(5) J Thoracic Surg 36 369 381 September 1958

reduced in 3 In another, the results were inconclusive and in 1, pulmonary hypertension developed with no change in the partition of flow In 2 persons in whom most of the nerves to one lung had been sectioned, unilateral hypoxia raised pulmonary arterial pressure and produced a questionable shift in flow

Unilateral hypoxia apparently can affect partition of blood flow between the lungs in human beings However, this effect is not invariably present and is noted only when concentration of oxygen in the inspired gas mixture is very low

Except for showing that nerves may not be important in the mediation of the response, the authors' data shed no light on the exact mechanism involved Observations in a normal person in whom pulmonary hypertension developed without a shift in flow suggest that two mechanisms may be present On one hand, the shift in flow may be caused by pulmonary hypoxia as a result of a local action not yet clarified On the other, the rise in pulmonary arterial pressure seems to indicate that both lungs were affected, a response which may be related somehow to oxygen tension in the blood

Studies of Pulmonary Function before and after Pulmonary Surgery in 450 Tuberculous Patients I Vital Capacity and Maximum Breathing Capacity John K Curtis Helene Bauer, Howard K Rasmussen and John T Mendenhall[6] (Madison, Wis) performed pre and postoperative pulmonary function tests on the 450 tuberculous patients The average interval between tests was 6 months Excellent correlation between the extent of the disease and loss in vital capacity and maximum breathing capacity was demonstrated Likewise the amount of lung tissue removed and loss of ventilatory function correlated well

Of 43 patients who had pneumonectomy, 29 had resection for scattered disease throughout one lung as demonstrated by roentgen examination and, in most, bronchospirometry confirmed the presence of significant functioning lung tissue In this group average loss of vital capacity was 37 5% and loss of maximum breathing capacity was 28 6% Fourteen patients had grossly destroyed lungs, with postpneumonectomy loss of vital capacity of 14 8% and maximum breathing

(6) J Thoracic Surg 37 598 605 May 1959

capacity of 11% Occasional large losses of function in patients having segmental resections and lobectomy resulted from complications, such as hemothorax, requiring drainage or reopening of the chest, extensive adhesions of the diaphragm, or inadvertent paralysis of the diaphragm

When the data for segmental resections were analyzed, the vital capacity and maximum breathing capacity lost varied directly with the number of segments removed

Several investigators have reported a "thoracotomy effect" that may be defined as "permanent loss of pulmonary ventilatory function as a result of opening the chest without removal of significant functioning lung" This concept seems somewhat unphysiologic No theoretical loss should result from opening of the pleura, provided no ribs are removed and no complications ensue Appraisal of application of this theory in resection of pulmonary tuberculosis is difficult because most patients lose function However, mean decrease in vital capacity and in maximum breathing capacity was slight in the segmental group of 189 patients (vital capacity, 6 3%, maximum breathing capacity, 1 4%) A number of patients, particularly in the segmental group, had improved function If thoracotomy effect was present in these patients, it was lost in the improvement noted

Angiocardiography as Aid to Identification of Nonresectable Pulmonary Carcinomas was studied by Stanley M Wyman and Earle W Wilkins, Jr[7] (Massachusetts Gen'l Hosp) Diagnosis must be established by other means because distinction between pulmonary carcinoma and certain other pulmonary conditions cannot properly be determined by *this technic*

TECHNIC—A no 11 or 12 Lehman catheter is introduced via the deep veins of the arm on the affected side into the corresponding innominate vein and 50 70 cc of 70% Urokon® is injected with a hand operated syringe in less than 2 seconds Serial films are made with a biplane roll film changing device, providing simultaneous antero posterior and lateral recordings at takes up to 12 frames/second in each projection Most examinations were done at a rate of 6 frames/second for 2 or 3 seconds, followed by 2 frames/second for another 5 or 6 seconds and finally 1 frame/second for a total run of 15 20 seconds

Angiocardiography was done in 23 patients Those with evidence of cyanosis, recent myocardial infarction, asthma

(7) J Thoracic Surg 35 452-460 April 1958



Fig 30—Vena cava azygos vein and trachea separated by enlarged azygos lymph node (Courtesy of Wyman S M and Wilkins E W Jr J Thoracic Surg 35 452 460 April 1958)

or serious allergy were not accepted for examination Despite careful selection, 2 patients had febrile responses 1 to 104 F, in 4 hours but temperature returned to normal in about 24 hours Urticaria occurred in 2 patients

The study showed the following results (1) Occlusion or severe narrowing of the left pulmonary artery, within 1 5 cm of its origin from the undivided pulmonary artery predicts inoperability of the lesion Concentric narrowing of the artery also suggests unresectability though less strongly (2) Occlusion or severe narrowing of the branches of the right pulmonary artery to the upper or lower lobes within 1 cm distal to its bifurcation, may occasionally permit resection of the right lung as it is possible to ligate the right pulmonary artery more proximally by opening the pericardium (3) A tumor that presses on the superior vena cava or innominate vein may invade the well and preclude resection

in contrast with a deformity of similar magnitude on an artery. This is particularly true if the indentation of the vein is nodular or if the vein is separated from normally adjacent structures (Fig. 30).

Prognosis is generally poor, even with a minor degree of distortion of the superior vena cava. Equally striking was the frequency of involvement of the left atrium.

Of the 23 patients examined, 13 were considered inoperable after angiocardiography and this opinion was confirmed during thoracotomy in 11. In the other 10, no evidence was found of involvement of the heart or great vessels; this impression was confirmed in 7 during operation. Unnecessary thoracotomy may be avoided when angiocardiography demonstrates unresectability.

Natural History of Carcinoma of Lung. George L. Emerson, Marion S. Emerson and Charles E. Sherwood[8] (Univ. of Rochester) studied 360 cases of proved bronchogenic carcinoma, with particular reference to the x-ray appearance of lesions on any past films before definitive diagnosis. Average interval between first symptom and clinical diagnosis was almost 7 months.

Certain early radiographic findings in cancer of the lung proved highly significant. Hilar, mediastinal and large parenchymal masses and gross atelectasis produce x-ray shadows strongly suggestive of carcinoma and are of serious prognostic import. Somewhat less obviously produced by a cancer but to be viewed with much suspicion are obstructive pneumonitis, the small hilar nodule, localized emphysema and thick-walled irregular abscesses. These carry a slightly less grave outlook when diagnosed without delay.

An isolated parenchymal nodule (Fig. 31) is malignant until proved otherwise. The smaller the nodule, the less apt it is to have other associated x-ray changes and the better is its prognosis. The small, persistent infiltrative density should be viewed with almost as much suspicion as the isolated nodule. It will most often be confused with a residual fibrous change from inflammatory disease, and the distinction, on pure radiographic grounds, is often impossible with a single film.

A definite factor in late diagnosis of carcinoma of the lung is the abnormal film which is read as normal. This happens

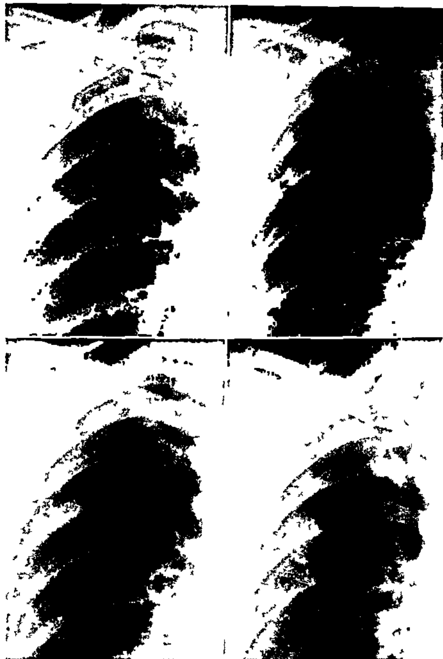


Fig 31 —Woman 53 without symptoms Lesion overlying 3d rib anteriorly on film of April 1948 was found on routine annual survey Growth of lesion on subsequent films during 2½ years is evident delay being primarily medical responsibility In November 1956 right upper lobectomy revealed adenocarcinoma Patient is well as of December 1957 (Courtesy of Emerson G L, *et al* J Thoracic Surg 37 291 304, March, 1959)

with even the most experienced eye and will not be completely eliminated However, all efforts can be constructively directed toward keeping this factor at a minimum In mass survey examinations, it is often not trained radiologists or chest specialists who interpret the films but other physicians, equally loath to miss a diagnosis but without the specialists' experience In such cases and even in the established x ray department, the ideal would include double reading of films, particularly normal ones A minimal change in the hilar shadow is frequently overlooked on a single film, where it would be more obvious when compared with a previous normal film

Some 44% of the patients had no film taken before the time of diagnosis or none was available Yet the changes present on admission films were such that many patients would have had positive radiographs if films had been taken during the preceding year An increase in the frequency of films should, therefore, provide earlier case finding

Confronted with a suspicious shadow on a chest film and a consequent suspicious lesion in the thorax, it is mandatory that there be continuity of observation and patient care Increasing numbers of patients suspected of a cancer of the lung today are given the advantage of modern methods of diagnosis Where the working diagnosis of pulmonary cancer is made more promptly on first recognizing abnormal x ray shadows, these diagnostic methods will be used earlier in the course of the disease A high index of suspicion will necessarily make more diagnoses than there are cases, and it cannot be presumed that all suspicious lesions will turn out to be cancer However, unless it is presumed they might the toll of bronchogenic carcinoma will not be significantly reduced

► [The prognosis for carcinoma of the lung following diagnosis is not good for the entire group however for patients who are operated on for carcinoma of the lung solely on the basis of an abnormal roentgenogram in the absence of symptoms the prognosis is much better with a 40 50% 5 year survival rate Consequently, the value of the routine chest roentgenogram is obvious Furthermore in a review of this problem it has become obvious that some patients with carcinoma of the lung have a relatively stationary growth for a number of years before the time that the lesion begins to metastasize In some instances in our institution we have been able to trace the progress of carcinoma of the lung for 5 years or more on successive roentgenograms during which time the lesion was simply observed (before admission to our hospital) In many such patients the

lesion has been nonresectable by the time exploration was undertaken, while in all probability a resection could have been performed had operation been done at the time the first roentgenogram revealed the lesion —Ed]

Vascular Invasion in Bronchogenic Carcinoma was studied in 59 surgically removed lungs or lobes by Alando J Ballantyne, O. Theron Clagett and John R. McDonald[9] (Mayo Clinic and Found.). Vessels were considered grossly involved by tumor in 28 specimens, but microscopic exam-



Fig 32 (left) —Squamous cell bronchogenic carcinoma within pulmonary artery Elastic van Gieson stain, reduced from ×30
Fig. 33 (right) —Small cell bronchogenic carcinoma within small branch of pulmonary artery Elastic van Gieson stain, reduced from ×30
(Courtesy of Ballantyne, A J, *et al* Thorax 12 294 299, December, *1957*)

ination revealed that 52 (88%) were affected. Of the 52, 10 showed definite arterial involvement. Because of difficulty in distinguishing arteries from veins in many instances, no distinction was made except in those in which identity of an invaded vessel could definitely be established. The malignant cells apparently had remarkable powers to infiltrate through vessel walls and often were found between the elastic laminae Analysis of the types of cells showed that arterial invasion was caused by squamous cell carcinoma (Fig. 32) in 5 cases, adenocarinoma in 2 and small cell carcinoma (Fig 33) in 3.

(9) Thorax 12 294 299, December 1957

Despite careful analysis of the history in each case, no correlation was found between the symptoms of bronchogenic carcinoma and vascular invasion within the tumor Of the 59 patients operated on, 3 died postoperatively, a mortality of 5% Of the 56 who survived, 55 were traced, 18 lived 3 or more years after operation Among these were 4 of 7 in whom the specimens showed no evidence of blood vessel invasion

Because of the large number of patients with carcinoma *of the lung invading the blood vessels, minimal manipulation* should be done during surgery and preliminary ligation of veins should be considered to increase survival rate Resistance of the host may be a prime factor in determining the fate of the malignant cells that gain access to the blood stream

Should We Insist on "Radical Pneumonectomy" as Routine Procedure in Treatment of Carcinoma of Lung? Julian Johnson, Charles K Kirby and William S Blakemore[1] (Univ of Pennsylvania) reviewed data on 344 patients treated for carcinoma of the lung between Jan 1, 1939, and Apr 1, 1953 Of this group, 56% had exploration and 34% had resection (table)

Radical pneumonectomy has been described as a procedure in which dissection starts at the apex of the mediastinum and

CARCINOMA OF LUNG, JAN 1, 1939, TO APR 1, 1953

	NO OF PATIENTS	%	5 YEAR SURVIVAL	
			NO	%
Clinical diagnosis	344			
Explored	192	56		
Resected	116	34	31	26 7
Operative mortality	9	7 7		
Pneumonectomy (standard)	99	7	26	26 4
Less than pneumonectomy	17	13	6	35

all areolar tissue and lymph nodes are reflected downward as the trachea, esophagus and other important structures, as well as the contralateral bronchus, are partially "skeletonized" The pericardium is resected with the lung and mediastinal tissues after the pulmonary vessels have been divided intrapericardially

The statistical data shows that radical pneumonectomy does not provide longer survival The explanation for this

(1) J Thoracic Surg 36 309 314 September 1958

may lie in recent findings regarding spread of pulmonary carcinoma through the blood vessels as well as through lymphatic channels Examination of surgical specimens revealed 71% with blood vessel invasion This factor was of greater prognostic significance than presence or absence of lymph node invasion All with undifferentiated carcinomas showed blood vessel invasion, whereas the latter was found in only 63% of those with epidermoid carcinomas, 45% of those with bronchiolar carcinomas and 12% of those with carcinoid adenomas

Of the 71 patients with blood vessel invasion, only 4 (6%) survived 5 years, whereas of 36 without blood vessel invasion, 27 (75%) survived 5 years Lymph node invasion was present in 53 patients, 8 (15%) of whom survived 5 years Of 54 patients without lymph node invasion, 23 (43%) survived 5 years Best results occurred in a group of 26 patients with neither blood vessel nor lymph node invasion 21 (81%) were 5-year survivors The size of the tumor does not seem to play a great role in the survival rate Invasion of the blood vessels or lymph nodes is the determining factor

► [As emphasized by these authors there is little evidence to indicate that routine use of so called radical pneumonectomy is attended with a significant increase in 5 year survival On the other hand there is considerable evidence to indicate that routine utilization of this procedure is attended wth a high operative mortality Such efforts in treatment of carcinoma of the lung have led some surgeons to extend their indications for resection beyond limits which will prove to be in the best interest of the patient —Ed]

Results in Treatment of Bronchogenic Carcinoma Analysis of 1,008 Cases was carried out by Thomas H Burford, Thomas B Ferguson and Harlan J Spjut[2] (Washington Univ) All the patients were treated for carcinoma of the lung between Jan 1, 1948 and Dec 31, 1955 There were 8 times as many men as women and ages ranged from 24 to 85 Follow-up was 1½ 9½ years The types of cancer encountered are shown in the table Of the 1,008 patients, 603 (60%) had exploratory thoracotomy and of these resection was done on 356 (35%) Of the latter, 280 (79 3%) had pneumonectomy, 74 (20 2%) lobectomy and 2 (0 5%) segmental resection Sixty nine (11%) patients died within the first 2 months after operation half due to cardiovascular complications The number of lobectomies in carcinoma of the lung

(2) J Thoracic Surg 36 316 328 September 1958

HISTOLOGIC DIAGNOSIS

TYPE	NUMBER	PER CENT
Epidermoid	572	57.0
Undifferentiated	287	28.5
Adenocarcinoma	107	10.5
Bronchiolar	13	1.0
Small (oat) cell	15	1.5
Mixed epidermoid and adenocarcinoma	14	1.5
Totals	1,008	100.0

has been steadily increasing. This rise is attributed to extended use of lobectomy in palliation in elderly patients with borderline respiratory reserve and in selected patients with small peripheral solitary tumors.

Of 482 patients treated between January, 1948, and July, 1952, follow-up of 461 (95.6%) provided the survival analy-

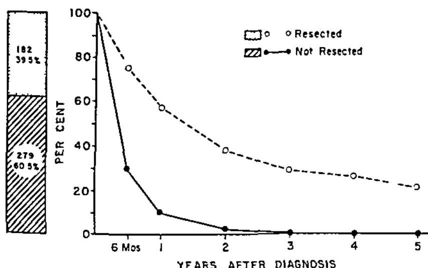


Fig. 34.—Survival of 461 patients January, 1948 to July, 1952. (Courtesy of Burford, T. H., *et al.*: J. Thoracic Surg. 36: 316-328, September, 1958.)

sis shown in Figure 34. Resection was done in 182 of the 461 patients, of whom 40 (22%) survived 5 years and 70 (38.4%) more than 2 years. The critical period of survival was the first 30 months after resection. Of those who survived this period, 75% became 5 year survivors. There were no 5 year survivors among the 279 inoperable patients though most had x-ray or chemotherapy or both.

Examination of resected specimens of the 40 long term survivors showed that epidermoid carcinoma was the predominant cell type, occurring in 31 patients. The specimens were further analyzed for frequency of lymph node and blood vessel invasion. A totally unexpected finding was that

in 18 (45%) involvement of the lymph nodes by tumor had occurred Three of the 40 patients had blood vessel invasion

Further Studies in Surgical Management of Carcinoma of Lung: Further Study of Cases Treated at Massachusetts General Hospital from 1950 to 1957 is reported by Edward D Churchill, Richard H. Sweet, J Gordon Scannell and Earle W Wilkins, Jr.[3] A study reported 8 years ago on patients treated between 1933 and 1948 is brought up-to-date,

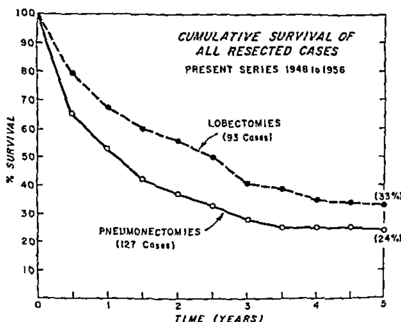


Fig 35 (Courtesy of Churchill E D, *et al* J Thoracic Surg 36 301 308 September, 1958)

and results in a second series of 341 resections done from January, 1948, to January, 1956, are included Survivors were followed to January, 1958 Whereas pneumonectomy was the treatment of choice, lobectomy was used, with removal of all gross evidence of the disease when there was reduced pulmonary or cardiac reserve, when diagnosis was uncertain and the lesion could be totally excised, when the lesion was small, peripheral and without evidence of lymph node invasion, and when the carcinoma extended beyond surgical bounds, but the bulk of the primary tumor could be removed in the hope of alleviating symptoms Most lobectomies were done, not merely as local excision of a primary growth, but as complete dissection of an anatomic unit of the lung, including adjacent lymph nodes

(3) J Thoracic Surg 36 301 308 September 1958

In the present series, 127 patients had pneumonectomy, with 10% mortality and 93 (43%) had lobectomy with 6 4% mortality In the original series, 87 patients had pneumonectomy and 34 (28%) lobectomy. The 5-year survival rate (Fig 35) was 24% among those with pneumonectomy and 33% among those with lobectomy. The factor responsible for the lower pneumonectomy survival rate was higher operative mortality, plus higher incidence (69%) of positive lymph nodes among the pneumonectomy patients, as against 36% in the lobectomy group The table shows 10-year cumulative statistics of the entire series In comparing the original and present series, two additional factors come to light The present series comprised more operable patients (55% compared to 43%) and the resectability rate also was increased to 35% from 25%

CUMULATIVE SURVIVAL ALL RESECTIONS 1933 56

TIME PERIOD ENDING (YEARS)	DEATHS	DROPPED FROM STUDY	PATIENTS ENTERING	PATIENTS AT RISK	PERIOD MORTALITY	PERIOD SURVIVAL	CUMULATIVE SURVIVAL
1	148	0	341	341	43	57	57
2	46	0	193	193	23 8	76.2	43
3	37	5	147	144.5	25 6	74 4	32
4	9	4	105	103	8 7	91.3	30
5	6	8	92	88	6 8	93 2	28
6	5	10	78	73	6 8	93.2	26
7	3	4	63	61	4 9	95 1	25
8	6	5	56	53.5	11.2	88 8	22
9	3	6	45	42	7.2	92 8	20
10	3	10	36	31	9 7	90.3	18

THE HEART

Nonpenetrating Traumatic Injury of Heart is discussed by Loren F Parmley, William C Manion and Thomas W Mattingly[4] *on the basis of 546 autopsy cases, representing* 0 1% of the 207,548 autopsy cases available for study at the Armed Forces Institute of Pathology Cardiac injury caused by nonpenetrating trauma is common, but often the lesion is minimal and morbidity slight Mortality from injuries of this type is low, and when death occurs, it most often results from cardiac rupture Forces responsible for producing these injuries are classified as direct, indirect, compressive,

(4) Circulation 18 371 396 September 1958

decelerative, blast, concussive and combined Myocardial rupture is the most common finding at autopsy, whereas myocardial contusion and pericardial lesions are the most common clinically

Almost invariably, ventricular rupture is immediately fatal, but survival after atrial rupture is possible, and since it is amenable to surgical treatment, prompt diagnosis is essential A patient may also survive rupture of one of the cardiac septa, particularly the interventricular septum This lesion may now be corrected surgically

Although myocardial contusions or traumatic pericardial lesions are often well tolerated, they may have serious sequelae Careful clinical evaluation of every injured patient *for possible cardiac trauma is imperative so that the more* serious complications may be recognized and treated promptly The effect of nonpenetrating trauma on a previously diseased heart is often serious The extent to which trauma aggravates a pre existent cardiac disease is often hard to assess

Thrombosis of a major coronary artery as a result of non penetrating trauma was not observed in the series

Aspiration Treatment of Cardiac Tamponade is strongly advocated by Henry P Royster and Lewis H Bosher Jr[5] (Med College of Virginia) because of its simplicity and effectiveness Among 17 patients treated since 1950, no deaths or serious complications occurred Aspiration was used alone in 13 (4 had 2 aspirations and 1 had 3) and with thoracotomy in 4, in 2 of the 4 it proved unnecessary One patient was readmitted with pericardial effusion 23 days after initial pericardicentesis and responded satisfactorily to repeated pericardial aspiration and antibiotics Cultures of aspirated fluid were negative In 1 patient, a right bundle branch block was still present 18 months after aspiration but with no symptoms and with cardiac fluoroscopy and venous pressure determinations normal

Since preparation of this report, 1 patient died after a stab wound of the main pulmonary artery and hemopericardium He was originally treated for hemothorax with no further bleeding Venous pressure was 130 mm saline He was ready for discharge 6 days later when severe back pain and shock suddenly developed Venous pressure was 220 mm

(5) A M A Arch Surg 77 117 122 July 1958

Systolic pressure rose to 60 mm Hg on administration of levarterenol Pericardial tap was advised 90 minutes after onset of symptoms, but cardiac arrest occurred before it could be carried out Immediate thoracotomy revealed hemopericardium and active bleeding from a 1 5 cm laceration in the pulmonary artery Resuscitation was unsuccessful

Pericardicentesis should be performed without delay, with a 17 gauge short-beveled spinal needle introduced by the subxiphoid approach Indications of successful aspiration are immediate rise in blood pressure, fall in venous pressure and improved sensorium Additional aspirations may be required, if tamponade recurs promptly, thoracotomy should be done

Sixty Penetrating Wounds of Heart Clinical and Experimental Observations are presented by James P Isaacs[6] Of 133 patients with penetrating wounds of the heart brought to Johns Hopkins Hospital from 1937 to 1959, 60 arrived alive and were treated, with a mortality of 16 7% The major complications were acute pericardial tamponade alone (40 patients), severe extrapericardial hemorrhage alone or a combination of both Blood was present in the pericardium in 94% of all the patients Mortality from gunshot wounds (4 of 7 patients) was greater than from stab wounds (6 of 53 patients) Mortality was much greater from severe extrapericardial hemorrhage than from pericardial tamponade alone A great arterial vessel or ventricle had been perforated in almost all who died

Choice of treatment depends on the existent complications (1) Pericardial aspiration and supportive treatment is preferable for acute pericardial tamponade alone Cardiorrhaphy was necessary in only one fourth of these patients Of 40 patients, only 1 (2 5%) died (2) Operative treatment should be quickly resorted to for the more serious complication of severe extrapericardial hemorrhage after initial nonoperative treatment proves inadequate for definitive therapy Cardiorrhaphy was necessary in one half of these patients The difference in statistics regarding results of operative versus nonoperative treatment of penetrating wounds can be accounted for in part by the difference in numbers of patients with severe extrapericardial hemorrhages in the various reported series

(6) Surgery 45 696 708 April 1959

The simplicity, low mortality and low morbidity of the *nonoperative treatment for a large segment of these* patients particularly those with tamponade, offers a practical rebuttal to the contention that all such wounds should have immediate surgical repair The high rate of operability and better recent results substantiate the virtue of operative treatment, particularly with severe extrapericardial hemorrhage Apparently, a higher percentage of patients had this type of complication in the series in which operative treatment was used predominantly

Chronic constrictive pericarditis after acute tamponade treated by pericardial aspiration was observed in 2 instances This incidence is not great enough to contraindicate the use of nonoperative therapy

► [This experience with nonoperative treatment of penetrating wounds of the heart is similar to ours both in volume of cases and results Three patients in our series have undergone subsequent pericardectomy for symptoms of constrictive pericarditis —Ed]

Traumatic Hemopericardium Producing Late Constrictive Pericarditis Report of Case is made by John W Raker Stephen B Langfeld and George F Gowen[7] (Pennsylvania Hosp, Philadelphia)

Man 37, had a stab wound of the left anterior chest Diagnosis was acute cardiac tamponade A pericardial tap removed 250 cc serosanguineous fluid Because of the fast reaccumulation of the fluid he had multiple pericardial taps with removal of fluid A pericardial biopsy revealed fibrinous pericarditis without evidence of specific inflammatory change or neoplastic disease Because of recurring symptoms pericardiectomy was performed The pericardium was thickened with inflammatory edema and was 7 12 mm thick The pericardial space was obliterated by adhesions and partially organized fibrinous material in many places He is doing well 1½ years after this operation and working at a job that requires considerable physical exertion There have been no symptoms suggestive of recurrent constrictive pericarditis

In a recent series of 43 patients with penetrating heart wounds reported from the Harlem Hospital 32 who survived more than a few moments and would agree to treatment were explored surgically The uncorrected mortality rate was 25% Pericardial aspiration was used as an emergency measure in preparation for operation The authors prefer operation to aspiration as the main reliance in these injured persons because (1) there are often associated serious injuries (2) the cause of death is believed often to be

(7) Ann Surg 148 134 138 July 1958

exsanguination, not cardiac tamponade, (3) results with aspiration alone have been disappointing, probably because of the difficulties encountered in removing clots through a no 18 needle, and (4) there is danger of development of late constrictive pericarditis if aspiration alone is used

Theoretically, a large blood clot in the pericardial sac might behave, under proper circumstances, like a large clot in the subdural space—as the outer portions of the clot are organized by invading capillaries and fibroblasts, the central portion liquifies With liquefaction, the protein molecules of the clotted blood are split progressively into smaller moieties The colloid osmotic pressure within the organizing clot rises and more and more fluid is contained within it as the process progresses In the pericardium, the fluid reaccumulates after tapping and the organizing clot 'layers" the ventricular muscles and forms a constricting sheath that hampers the muscular action

► [The occurrence of this complication following aspiration therapy in traumatic hemopericardium would appear to be relatively uncommon In the preceding report by Isaacs, for example there were only 2 instances in 133 cases Similarly, we have observed this complication in only 3 patients in a comparable series Accordingly, such a low incidence cannot be considered adequate basis to contraindicate the use of this method of treatment —Ed]

Constrictive Pericarditis was studied in 62 cases by T M D Gimlette[8] (St Thomas's Hosp, London) In 28 patients, constriction developed within a year of an attack of pericarditis, in 34, onset of constriction was insidious Proof of tuberculosis was obtained in 17 in 2, tubercle bacilli were found in the pericardial fluid and there was histologic proof, 4 showed only bacteriologic and 11 only histologic findings No patient had a history of myocardial infarction or of significant trauma to the pericardium In 1 patient severe constrictive pericarditis developed after suppurative pericarditis, the pericardium was infected with Bacillus coli from a subphrenic abscess Constriction with secondary carcinoma in the pericardium was observed in 3 patients Two had heavy prophylactic irradiation of the mediastinum after removal of seminomas One had acute pericarditis during therapy, constriction developed within a year and was cured by operation In the other, constriction developed insidiously and was not improved by operation Five patients had active rheumatoid arthritis, 4 of them for some years

(8) Brit Heart J 21 9 16 January 1959

before cardiac symptoms. In the other, arthritis developed 3 months after an acute pericarditis which initiated constriction. In 1, chronic constriction and nephrosis arose together.

Acute constrictive pericarditis demands surgical treatment. Mechanical constriction predominates, and diagnosis is usually not difficult. The sooner pericardiectomy is done, the better the results. Operation should not be delayed more than 1-2 weeks, unless signs of constriction are rapidly diminishing; the severe case may be regarded as an emergency. Three patients operated on 1-15 years after constriction first developed were not cured. Nearly all those operated on within a year of onset of constriction did well. Of 42 patients operated on, 15 (36%) were cured, 17 (40%) were unchanged or improved and 10 (24%) died.

Streptomycin fails to prevent constriction in many cases of tuberculous pericarditis. In 2 of 12 patients who received a preliminary course of streptomycin, a symptomless state was reached, with minimal constrictive signs. One died of pulmonary embolism before operation. Nine operated on after streptomycin had no better results than other comparable patients. Only 1 patient died of pulmonary tuberculosis a year after operation, despite streptomycin treatment, and none died with disseminated tuberculosis.

In chronic constriction, medical treatment should be preferred initially, particularly if many features unfavorable for surgery, e.g., age, cardiac enlargement or rheumatoid disease, are present. Such patients tend to lose ground, and then many are helped and a few are cured by pericardiectomy. Doubt about diagnosis, particularly in certain chronic cases with much myocardial damage, may be resolved only by thoracotomy. In such patients, however, results of pericardiectomy are usually poor.

Review of Cases of Cardiac Arrest at Vanderbilt University Hospital and Thayer Veterans Hospital. Lawrence G. Schull[9] tried to ascertain the rate of occurrence and possible etiology of cardiac arrest occurring during anesthesia and surgery. The term "cardiac arrest" is used to designate patients in whom heart failure was more or less unexpected.

There were 79 cardiac arrests. Complete recovery occurred in 17. Cardiac arrest occurred in 28 patients (35.4%) having cardiac surgery and in 51 noncardiac surgical pa-

(9) South. M. J. 52 143-146, February, 1959

tients Patients having abdominal surgery made up 59%, 10 (35 7%) recovered Cyclopropane and ether were associated with 40 5% of cardiac arrests, thiopental-nitrous oxide with 20% and nitrous oxide-oxygen-ether with 16 2% The incidence of cardiac arrest in the 1st decade of life was 25 3% Of these 20 patients, 12 were having cardiac surgery The recovery rate was much lower in this age group than in the others, probably due to the higher incidence of cardiac surgery In patients aged 60 70 there were 10 cardiac arrests and the recovery rate was 60%, almost twice the average recovery rate for noncardiac surgery patients

It appears that most cardiac arrests were preventable The table presents probable causes of arrest in the noncar

CAUSE OF ARREST (NONCARDIAC CASES)

	ARREST	RECOVERY
Interference with gaseous exchange	22	10
Fall in blood pressure		
Spinal anesthesia	3	
Traction	8	3
Rapid increase in depth of anesthesia	2	2
Palpation of pheochromocytoma	1	
Undiagnosed pheochromocytoma	1	
Diodrast® reaction	2	
Hemorrhage	6	1
Coronary	3	
Moribund	3	
Total	51	16

diac surgical cases Interference with gaseous exchange, leading to hypoxia and/or hypercapnia, accounted for 22, hypotension associated with spinal anesthesia for 3 and rapid increase in depth of anesthesia for 2, giving a total of 27 which were due to an error in anesthetic management or technic, or 53% of the total of 51 noncardiac cases

Of the noncardiac patients who recovered, all were in asystole when the heart was exposed All responded to min imal resuscitative manipulation—2 or 3 massages Within 2 5 minutes, the blood pressure was normal, the eyes reactive and moving and the patient breathing Postoperatively, these patients awoke more slowly than the average but were normal within 5 6 hours after the cardiac arrest The time of the arrest in this group was such that the oper ation had to be completed in 7 Each patient had to be given more anesthesia for completion of the operation

Clinical Use of Hypothermia Following Cardiac Arrest When the interval between cardiac arrest and restoration of

circulation by massage exceeds 3-4 minutes, central nervous system injury prevents survival Unconsciousness, evidence of progressive brain swelling and finally death are all too familiar Hypothermia reduces cerebral swelling in patients having intracranial operation and has been reported to be beneficial after brain injury Therefore, G Rainey Williams, Jr, and Frank C Spencer[1] (Johns Hopkins Univ) used hypothermia in treating 4 patients with evidence of central nervous system damage after cardiac arrest that occurred outside the operating room Cardiac massage was begun within 4 6 minutes All patients were treated promptly with hypothermia (30 34 C), which was maintained up to 72 hours Three recovered completely, and 1 showed a moderate residual defect affecting visual acuity, which improved somewhat with time

Few conclusions can be drawn from this uncontrolled clinical series, but it seems significant that at the authors' institution during the past 10 years, no more than 5 patients excluding the present patients, have survived cardiac arrest outside the operating room area

As a result of clinical and experimental experience (hypothermia, instituted after anoxic injury, increased survival rate in dogs), the authors suggest that patients who show evidence of central nervous system damage after cardiac resuscitation should be promptly cooled to 32-34 C and maintained at this temperature until there is evidence of return of neurologic function The Thermo rite circulating mattress has proved satisfactory for this purpose Tracheotomy should be performed at the outset and respirations supported by a mechanical respirator if necessary Shivering has not been a problem Early attention to blood volume, electrolyte balance and renal function is essential

Patent Ductus Arteriosus in Adult with Partial Reversal of Flow is reported by Paul Winchell, James Redington and Richard L Varco[2] (Univ of Minnesota) in 2 women, aged 44 and 21 Both presented the common finding of progressively severe exertional dyspnea The older patient presented the more typical physical finding of regional cyanosis and clubbing limited to the lower extremities Variations of this

(1) Ann Surg 148 462-466 September 1958
(2) Dis Chest 34 181 192 August 1958

sign have been reported, since there may be retrograde flow of pulmonary artery blood into the left subclavian artery or even into the root of the aorta causing cyanosis of the upper portions of the body in general

This more atypical finding was noted in the younger patient at exploratory operation The older patient showed the usual polycythemia, right ventricular hypertrophy on fluoroscopy and a right ventricular strain pattern on the ECG with large pulmonary artery segments A well calcified ductus arteriosus could also be seen and demonstrated on x ray films The younger patient apparently had not been in a state of reversal long enough to show polycythemia A Graham-Steell type regurgitant murmur was heard, although the pulmonary systolic murmur was much more prominent That pulmonary hypertension may be progressive and reversal of flow occur relatively late in life, supporting the idea that hypertension may be acquired rather than congenital, was demonstrated by the younger patient

In the older patient, changes in response to breathing 100% O_2 as determined by studies of femoral oxygen saturations, suggested that pulmonary vascular resistance became fixed as the disease progressed At operation, the ductus arteriosus was estimated to have a diameter of 20 25 mm , was thickened and contained calcium Thrombi were evident in all branches of the right pulmonary artery, with widespread calcific deposits in the arterial wall The proposed anastomosis of the left atrium to a branch of the pulmonary artery could not be done because thromboses were present throughout the smaller pulmonary arteries Tentative clamping of the ductus arteriosus was attempted to note the tolerance of the heart for altered hemodynamics The cross-clamping eventuated promptly in ventricular fibrillation In the younger patient, correction operation was not attempted at exploratory thoracotomy

Clinical and experimental observations demonstrated that increased pulmonary blood flow results in pulmonary hypertension that may be followed by pulmonary arteriolar, medial and intimal thickening and increasing pulmonary vascular resistance, especially if the flow is of the pulsatile type

Cardiovascular Surgery in Children's Hospital II Cyanotic Lesions Review of 193 Operations is presented by

Rachel Ash, Julian Johnson, C Everett Koop, Sidney Friedman and William Rashkind[3] (Philadelphia) The mortality was 20% In 164 operations on cyanotic children with potentially operable lesions, there were 19 (11 6%) deaths and 12 (7 9%) late deaths In 29 operations on cyanotic children with inoperable lesions, including complete transposition of the great vessels, there were 20 deaths In 10 operations on cyanotic children with valvular pulmonary stenosis and intact ventricular septum, there was 1 death Excellent clinical results were obtained in the survivors

A shunt procedure was used in all but 3 of the 126 patients in whom a definitive operation was performed for tetralogy of Fallot The operative mortality was 8% and late deaths constituted 7% A good clinical result was obtained by 80% Time alone will tell whether correction of this lesion under direct vision will improve these results A shunt procedure was performed on 11 children with tricuspid atresia In 2 an atrial defect was also created There was 1 operative death and 4 late deaths The survivors show a greater degree of cyanosis than is usually seen in the child with tetralogy of Fallot

Only 4 of 17 infants survived after various operations for correction of transposition of the aorta and pulmonary artery An atrial septal defect was created in each of these survivors It is difficult or impossible to correct total transposition of the pulmonary veins fully without cardiopulmonary bypass, though considerable improvement was obtained in 3 of 5 patients on whom a pulmonary vein was anastomosed to the left atrial appendage under hypothermia Right lower lobectomy was performed on an extremely cyanotic girl with pulmonary arteriovenous fistula, resulting in immediate disappearance of the cyanosis

Twelve children had incorrectly or incompletely diagnosed lesions for which no suitable operation was available at time of surgery There were critically ill children referred in a desperate hope that an operable lesion might be found In this group were 3 infants with pulmonary atresia on whom a shunt operation was performed, but who at autopsy, were found also to have had a common atrioventric ular canal Two had asplenia One infant with truncus arte

(3) J Pediat 54 348 362 March 1959

riosus and 1 with total transposition of the pulmonary veins were explored for possible patent ductus A cyanotic infant with Ebstein's deformity of the tricuspid valve was suspected of having pulmonary stenosis, as was a girl, aged 15, with reverse ductus and a pulmonary artery overriding a ventricular septal defect

Late Results of Operations for Fallot's Tetralogy were studied by Maurice Campbell[4] (Guy's Hosp, London) in 101 patients Follow-up was 6 10 years Some of the patients who obtained good results after anastomotic or direct operation for Fallot's tetralogy lost all or part of their improvement during subsequent years Often this was due to the inevitable risks of the condition, because all the patients still have Fallot's tetralogy, though the stenosis has been somewhat relieved, directly or indirectly These causes, especially cerebral complications, were responsible for more than one third of the deaths, the heart could not support the increased pulmonary flow and the increased activity that it allowed in another one-third, but in the final one-third, the cause was not directly related to the heart condition or the operation In many patients who lost all their improvement after anastomotic operations, however, this was due to closing of the anastomosis In others, and in most of those who lost some of their improvement after both types of operations, it was due to the tendency for the stenosis to become more severe

Of those who obtained good results, 80% have maintained them for an average of 7 years after anastomotic operations and 89% for 5 vears after direct operations The long term advantage of the direct operation is greater than appears from these figures, because there were only half as many deaths and half as many who lost all their improvement with direct as with anastomotic operations It is estimated that perhaps one half of those who obtained good results may be reasonably well 20 years after operation

After anastomotic operations, increasing difficulty in hearing the continuous murmur is a bad sign, if it cannot be heard, the anastomosis has probably closed The auscultatory signs after direct operations are not so helpful The reduction in the anoxemia and resultant polycythemia and

(4) Brit M J 2 1175 1184 Nov 15 1958

high hemoglobin percentage that was found 3 or 4 years after operation has been maintained in most patients for 6-10 years, but not in those who had lost their clinical improvement. The heart increases in size within a few weeks after a successful anastomotic or direct operation. On the average, the cardiothoracic ratio increases by one-tenth (49-54%) and remains at this level 8-10 years.

Results after direct operations suggest that when the ventricular septal defect can be closed, it should not be difficult to relieve the infundibular or valvular stenosis.

Late Hemodynamic Complications of Anastomotic Surgery for Treatment of Tetralogy of Fallot, according to Richard S. Ross, Helen B. Taussig and Melvin H. Evans[5] (Johns Hopkins Univ.), are of two types: (1) cardiac en-



Fig 36 (left) —Chest x ray 5 years after operation
Fig 37 (right).—Eleven years after operation
(Courtesy of Ross, R S, *et al.* Circulation 18 553-561, October, 1958)

largement and congestive failure similar to that seen in patients with arteriovenous fistulas and (2) pulmonary hypertension, aneurysmal dilatation of the pulmonary artery, decreasing shunt, return of cyanosis, cardiac failure and death. Both can be related to a shunt of greater than ideal size.

Of 17 patients, 8 had enlargement of the pulmonary artery. In 2, the hematocrit value rose and cyanosis returned; both died. It seems likely that the other 6 also had pulmonary hypertension which reduced the volume of the shunt but

(5) Circulation 18 553 561, October, 1958

that the critical level at which cyanosis and polycythemia return had not been reached Only 2 had signs of congestive heart failure Another patient had cardiac enlargement and a wide arterial pulse pressure but no signs of congestive failure In 8, progressive increase in heart size was the only indication that the shunt was too large

No meaningful estimate of the incidence of these complications can be made before completion of the survey of all patients who were living 10 years after operation Figures 36 and 37 shows chest x-rays of a boy who died in the 12th postoperative year

Eleven of the 17 had end-to end subclavian to pulmonary anastomoses In 2, the innominate artery was used, and in 4, an aorta to pulmonary anastomosis was constructed Thus, the larger anastomoses constitute more than a third of the patients in this group, representing a much higher frequency than in the entire operated population

Surgical Treatment for Tetralogy of Fallot by Open Intracardiac Repair is effective, according to John W Kirklin, F Henry Ellis, Jr, Dwight C McGoon, James W DuShane and H J C Swan[6] (Mayo Clinic and Found), who since April, 1955, used this method on 74 patients Twenty-one (28%) died in the hospital, including the first 5 The hospital mortality rate among the 69 subsequent patients was 23%, and among the last 25, 16% Good relief of pulmonary stenosis can be achieved in about a third of the patients by radical resection of the crista supraventricularis, alone or with valvotomy (Fig 38), and in about a third, only proper use of polyvinyl (Ivalon) sponge for enlargement of the outflow tract will suffice Even the difficult condition with a long, narrow outflow tract, narrow pulmonary valve ring and narrow pulmonary artery can be successfully treated by proper Ivalon reconstruction Need for complete reconstruction is found in the other third of the patients

In 7 of 21 patients who died, failure to relieve adequately the pulmonary stenosis was a significant factor One additional patient died, 6 weeks after returning home, of intractable right heart failure, which probably resulted from poor relief of pulmonary stenosis In 3 of those who died, there was incomplete repair of the ventricular septal defect, in 2

(6) J Thoracic Surg 36 22 51 January 1959

of whom death occurred with progressing hypotension Of 4 patients who had anomalies of coronary arteries, 2 died because a large branch of the right coronary artery was divided during entry into the right ventricle. In 2, the large anomalous branch from the right coronary artery was preserved: 1 patient made an uneventful recovery; and 1 died,

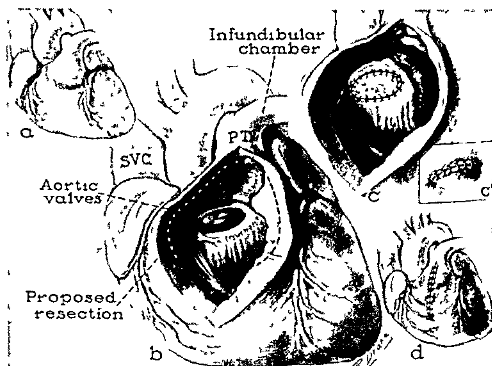


Fig 38—Open intracardiac repair of tetralogy of Fallot with infundibular chamber and wide pulmonary valve ring and artery Unopened heart (a) First step after ind- [illegible] of hypertrophied crista supraventricular [illegible] stenosis (b) Pulmonary valvotomy is per[illegible] al defect then is repaired by direct sut[illegible] (c) If careful examination now dis clo[illegible] and pulmonary valve ring and artery, pla[illegible] entriculotomy is closed (d) (Courtesy of [illegible] 36 22 51, January, 1959)

presumably of other causes In 4 of the 21 who died, complete atrioventricular dissociation in the postoperative period was significant.

In early operations, blood volume was probably not maintained as constant as in recent operations. However, values for left atrial pressure after repair do not support a belief that left ventricular failure was present, as was originally thought Since the first 5 patients died, only 1 other has died of frank pulmonary edema.

Of the 53 survivors of the postoperative period, 4 died after

leaving the hospital Eleven were operated on recently, the other 38 are enjoying full activity and are completely without symptoms Of the 49 survivors, 5 have only fair relief from pulmonary stenosis, but are asymptomatic, 1 operated on recently has had poor relief from pulmonary stenosis, and 6 have proved or suspected small left-to-right shunt at the ventricular level, which to date has caused no symptoms

No patient with tetralogy of Fallot is considered too ill for operation and previous operation is not considered a contraindication Accurate and complete intracardiac repair is time-consuming, 30-40 minutes of induced cardiac asystole and a total perfusion time of 40-70 minutes are usually required Accurate visualization and repair of the ventricular septal defect are accomplished in a fashion similar to that for isolated ventricular septal defect Associated lesions, such as atrial septal defect or patent ductus arteriosus, must be identified and repaired

Results of Open Heart Surgery with Elective Cardiac Arrest by Potassium Citrate in Patients with Congenital and Acquired Heart Disease are reported by F Mason Sones, Jr [7] (Cleveland Clinic) In elective cardiac arrest, the heart is isolated from the systemic circulation by occluding the vena cavae and clamping the ascending aorta, after establishing the usual cannulations for maintenance of the circulation with a pump oxygenator The potassium solution—a mixture of 25% potassium citrate solution, diluted 1 10 with blood—is injected into the root of the aorta proximal to the clamp, so that it rapidly perfuses the coronary circulation

Complete asystole, with a soft, flaccid heart, occurs as soon as total perfusion of the coronary artery bed has been accomplished The heart remains in asystole until the aortic clamp is removed, permitting the potassium solution to be washed out of the coronary circulation by arterialized blood from the pump oxygenator Adequate perfusion of the coronary arteries with arterialized blood, under essentially normothermic conditions, results in prompt return of normal heart rhythm This technic provides adequate surgical exposure for as long as 60 minutes in a quiet, reasonably dry field, inside any of the heart chambers

The technic was used in 80 open cardiotomies Patients

(7) Dis Chest 34 299 316 September 1958

were aged 2 months to 58 years Body weight varied between 7 and 190 lb There were 35 deaths In no instance was death or surgical failure attributable to the use of cardiac arrest Although the basic nature of the defect has an important bearing on surgical mortality, this does not reflect other important factors, such as age, body mass, myocardial reserve anoxia, pulmonary vascular disease and degenerative changes in the systemic circulation, which often proved to be crucial in achieving success or failure within each group The largest number of patients (62 5%) had interventricular septal defects or tetralogy of Fallot, 9 had acquired lesions including 1 with an interventricular septal defect due to septal myocardial infarction The other lesions were congenital in origin

The high mortality rate is a reflection of a combination of the following factors errors in diagnosis and judgment in selection of patients failures in immediate postoperative care, particularly with regard to atraumatic maintenance of adequate ventilatory function in infants and small children, surgical errors preventable in view of previous experience surgical errors inevitable at present because of lack of precise enough understanding of extremely complex and infinitely varied intracardiac pathologic anatomy, and incomplete solution of the problems involved in total artificial perfusion

The postoperative status of surviving patients was evaluated on the basis of clinical findings and by heart catheterization and cinecardioangiography 6 14 months after operation Anatomic correction with restoration of normal function may be anticipated in patients with atrial or ventricular septal defects provided complete absence of the septum is not encountered Severe pulmonary hypertension is not a contraindication to closure of septal defects if there is a large left to right shunt with increased pulmonary flow In patients with tetralogy of Fallot, inadequate closure of the ventricular septal defect was found in most instances when a prosthesis was not incorporated into the defect These patients showed clear cut evidence of functional improvement, with increased pulmonary blood flow and relief from arterial hypoxemia, but anatomic correction and restoration of normal cardiovascular dynamics was usually not obtained

Use of potassium citrate in the production of elective cardiac arrest for open heart surgery is a routinely applicable procedure, which is completely reversible It increases surgical efficiency without additional hazard to the patient

► [An increasing number of reports are appearing suggesting that potassium citrate may be toxic to the myocardium Our own results have improved since cardioplegics were discontinued in open heart surgery Myocardial contractions and function after operation in our patients have appeared to be better when cardiac standstill is not induced —Ed]

Forty-Four Operations on Open Heart under Extracorporeal Circulation were reviewed by Ch Dubost, Ph Blondeau, Cl Lenfant, M Weiss, J Passelecq, J Guery, A Piwnica and L Sprovieri[8] (Paris) The first 18 were performed with the Lillehei-DeWall apparatus and the others with the Melrose oxygenator with rotary disks Either bilateral thoracotomy, with transverse sternotomy, or unilateral thoracotomy on the right, which could be extended toward the left and had the advantage of causing less respiratory difficulty was used At first, cannulas were used in the left subclavian but now, even in children, the femoral artery is used Venous catheters are inserted across the right auricle into the venae cavae In 8 instances, intentional cardiac arrest was used with extracorporeal circulation This was obtained by clamping the ascending aorta and injecting potassium citrate into the coronary bed Return of heart beat was accomplished by unclamping the aorta, thus permitting the perfusion to remove the potassium solution

Mortality for the series was 29 5% (13 patients) Some deaths were due to technical errors, which diminished considerably with experience, and some were due to the intervention itself and to physiopathologic cardiorespiratory changes In 19 operations for interauricular communications, some of which required plastic procedures with Ivalon, 4 for valvular pulmonary stenoses, 1 for aneurysm of Valsalva's sinus and 1 exploratory ventriculotomy, no deaths occurred Death resulted in 2 of 4 patients with atrioventricular canal, 4 of 7 with interventricular communications, 1 with a single ventricle with inversion of vessels, all of 4 with infundibular pulmonary stenoses, 1 of 2 with tetralogy of Fallot and 1 with mitral insufficiency

The authors believe that the problem of cardiac drainage

(8) Semaine hop Paris 34 1759 1770 June 18 1958

11 had valvular stenosis, 7 subaortic and 2 combined valvular and subaortic stenoses Ages varied between 4 weeks and 18 years and 4 patients under age 2 months were operated on as emergencies None with congenital stenosis died Several patients had mild to moderate aortic regurgitation after operation, but, for the most part, functional results were good

Most patients operated on for acquired aortic valvular stenosis had severe cardiac disability, cardiac strain and frank congestive failure This accounted for a mortality of 27% of 22 patients after operation

Disposable Filming Pump Oxygenator Experimental and Clinical Use in 70 Patients is reported by *John J Osborn* Frank Gerbode Herbert Perkins Mark Braimbridge Denis Melrose and Paul Kahn [1] In the requirements for a practical blood oxygenator, cleanliness and disposability rank high Successful perfusion demands that all surfaces that the blood touches be pyrogen free and scrupulously clean

Apparatus —Oxygenation is accomplished by a blood film spread on the inside of a series of partly inflated polyvinyl bags The specially prepared polyvinyl sheeting is extremely hydrophobic and essentially free from soluble plasticizer The bags are inserted into a Lucite retaining frame then inflated against the frame with oxygen containing 6% carbon dioxide Blood is introduced into the top of each bag through a silicone treated glass manifold ending in a Y shaped distributing tube for each bag The distributing Y tubes oscillate or rock back and forth inside the bags and spread the blood into an even film on the inside of the bag at the top The apparatus is shown in Figure 40 The bottom of each bag acts as a blood reservoir and drains into a common collecting manifold Blood is continuously withdrawn from the collecting manifold and pumped back to the distributing tubes at the top of each bag to maintain the film There is no bubbling or foaming

The pumps are the Gibbon type consisting of several parallel tubes pressed by a revolving pair of rollers Collection of blood from venae cavae has been through soft plastic catheters introduced through purse string sutures in the right atrium These catheters come together to a Y connector and drain by gravity to one end of the collecting manifold of the pump oxygenator The lung bags and their input and output tubes are held in a Lucite retaining frame The weight (hence the volume) of the blood in the lung and reservoir system controls output of the arterial pump Each pump is operated at a speed that can be manually varied by the operator

Arterial pressure is monitored by polyethylene tubing inserted into the internal mammary artery Venous pressure is monitored by a polyvinyl catheter inserted through the long saphenous vein in the

(1) J Thorac Surg 37 472-481 April 1959

filters for practical use in a blood pump-oxygenator system.

The oxygenator consists of two draw-formed half shells of methyl methacrylate that fit together to form a cylinder, with proper fittings in each end to receive and discharge the blood and gas (Fig. 41). A deep well on the discharge end of the oxygenator insures that bubbles will not be introduced into the stream of oxygenated blood. The disks are injection molded from methyl methacrylate. The bubble trap and co-

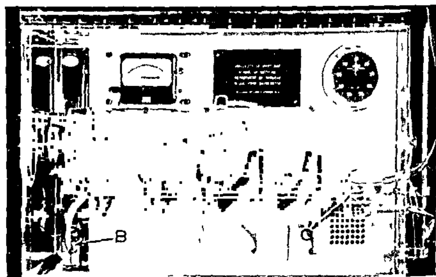


Fig 41.—*A*, disposable plastic oxygenator, *B*, Mark De Bakey pump, *C*, arterial line with bubble trap and filter Thermometer, tachometer flowmeter, emergency crank and warm air ports are clearly visible (Courtesy of Esmond, W G, and Cowley, R. A.: Am Surgeon 24 685 688, October, 1958)

ronary return units consist of two half shells of methyl methacrylate cemented together, with a screen separating the two halves.

A unit can be removed from a box and mounted quickly in the pump-oxygenator. The 13-in. unit is primed with 3 pt blood and time is allowed to oxygenate the blood and to clear all bubbles from the line by slowly recirculating. The pump is then stopped and the coiled line connecting the bubble trap and the oxygenator cylinder is passed to the operating table where it is cut and connected to the venous outflow and arterial inflow lines. After the usual cardiopulmonary bypass procedure, the unit can be quickly removed from the machine and discarded.

Trials in open heart surgery in the dog laboratory indicate that the expendable disk oxygenator is as effective as the

Kay-Cross oxygenator and gives completely oxygenated bubble free arterialized blood

In using a disk-type oxygenator, the operator must always be aware that the level of the blood in the oxygenator determines the surface area of the blood exposed to oxygen, and as the level in the oxygenator drops, less and less area is exposed If the oxygenator barely meets the need for a given blood flow when fully primed, every effort must be made to maintain this level during a run by adding heparinized blood from the reservoir bottles To allow a safety factor for changes in blood level, it would be most wise to choose a unit among the four sizes being produced that has at least 50% excess oxygenation capacity when fully primed

Comparison of Relative Merits of Occlusive and Nonocclusive Pumps for Open Heart Surgery. Together with Description of Simple Flowmetering Method for Clinical Use is presented by Paul C Hodges, Jr, Richard Cardozo, Andre Thevenet and C Walton Lillehei[3] (Univ of Minnesota) Selection of a pump to replace cardiac function temporarily during total cardiopulmonary bypass is an important consideration, better based on objective evidence than on personal caprice At present, legitimate differences of opinion concerning optimal pumping systems exist among different groups engaged in such work

The authors have had extensive laboratory and clinical experience with two types of pumps a multiple cam actuated finger pump manufactured by the Sigmamotor Company and a roller pump made by the Mark Company Some apparent differences in performance were noted Controlled experiments were aimed at (1) comparison of performance characteristics against known resistance and (2) evaluation of trauma to the circulated blood

No significant differences in outputs were found between roller and Sigmamotor pumps, on the basis of presence or absence of total occlusion, so long as the line pressures developed were comparable Since flow is a function of the pressure drop across the circuit, it is feasible to measure flow accurately during clinical perfusions by a flowmeter A calibration curve may be constructed for any type of pump, occlusive or nonocclusive, with a series of the commonly used

(3) J Thoracic Surg 36 470-478 October 1958

arterial cannula sizes such that for a particular pressure drop in the arterial line the flow is known During clinical perfusions the calibration curve for the cannula size used is selected, the mean aortic pressure is subtracted from the pressure developed in the line, and the flow determined at any time during the perfusion Since continuous recording of the arterial pressure is recommended as a routine procedure in clinical perfusions, the only other measurement needed to determine flow is obtained with a line-pressure monitor

Hemolysis is a direct function of stroke volume, rather than of pump design or presence or absence of total occlusion, in the pumps studied No significant change in fibrinogen level was noted during recirculation of blood

The ability of totally occlusive pumps to maintain stable flow, despite considerable variation in systemic resistance, indicated their advantage over partially occlusive pumps in clinical perfusions

Use of Totally Occlusive Pump as Flowmeter with Observations on Hemolysis Caused by Occlusive and Nonocclusive Pumps and other Pump Oxygenator Components was evaluated by James S McCaughan, Jr, Harrison McMichael John C Schuder and Charles K Kirby[4] (Univ of Pennsylvania) Use of a totally occlusive roller pump produced flow rates which were independent of the resistance, from 10 to *more than 600 mm Hg, and was shown to* serve as a simple and reliable flowmeter The rate of free plasma hemoglobin formation did not exceed safe limits, being 43 mg/100 ml when 3,380 cc blood was circulated at a flow rate of 3,000 cc/minute It was necessary to use rubber rather than plastic tubing in the pump, because plastic tubing split when used under conditions of total occlusion A totally occlusive De Bakey pump caused significantly less hemolysis than a totally occlusive Sigmamotor pump

Most hemolysis in the extracorporeal circuit was caused by the pump, and the contribution of the screens connectors, *filter and other components was negligible However*, in the suction apparatus, bubbling phenomena were the major cause of hemolysis when not controlled The rate of hemolysis of heparinized blood was essentially the same as that of blood collected in A C D solution

(4) Surgery 44 210 219 July 1958

It is believed that an occlusive pump is necessary if the determination of the flow rate is dependent on preperfusion calibration Moreover, use of an occlusive pump most simply and reliably insures an accurate flow rate independent of resistance Patients may be subjected to perfusion rates far lower than assumed if these principles are not understood and applied, and inadequate perfusion rates may be lethal

Experimental and Clinical Comparison of Bubble Dispersion and Stationary Screen Pump Oxygenators was made by James V Maloney, Jr, William P Longmire, Jr, Karl J Schmutzer, Samuel A Marable, Ekkehart Raschke, Yutaka Watanabe, Ervin L Lobpreis and James E Arzouman[5] (Univ of California, Los Angeles) Three types of pump oxygenators were used the bubble dispersion oxygenator described by DeWall and his associates, with modifications (Fig 42, *A*), a modified stationary screen oxygenator of the Gibbon type (*B*), and a combination of this stationary screen oxygenator and commercially available roller pumps of the De Bakey type (*C*)

Metabolic acidosis does not occur in patients with the screen oxygenator at flow rates over 70 ml/kg body weight/minute Increase in plasma hemoglobin values and decrease in platelet count were about the same with both oxygenators Experimental survival rate with the screen oxygenator is higher than with the bubble oxygenator, and this difference becomes more pronounced at higher flow rates Air embolism was demonstrated with use of the bubble oxygenator by (1) direct observation of a capillary tube placed parallel with the arterial line, (2) an anaerobic sampling technic, (3) a plenum chamber and (4) negative pressure tissue fixation technic

A perfusion syndrome associated with cardiac bypass, characterized by areflexia, hypotension, confusion and restlessness was demonstrated experimentally and clinically to be due to microscopic air embolism The occasional occurrence of the perfusion syndrome was due to air embolism originating from a coronary aspirator system or from air trapped in the apex of the left ventricle Clinical use of cardioplegia increased the likelihood of air embolism from the

(5) Surg Gynec. & Obst 107 577 587 November 1958

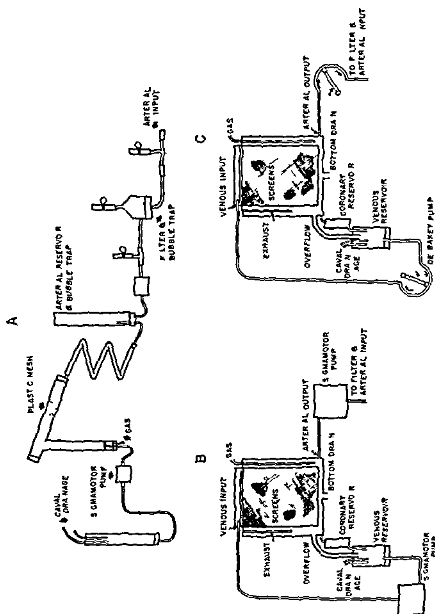


Fig 42—Extracorporeal circuits used in study *A* dispersion oxygenator with Sigmamotor pump *B* stationary screen oxygenator substituted for dispersion oxygenator *C* stationary screen oxygenator with De Bakey pump (Courtesy of Maloney J V Jr *et al* Surg Gynec & Obst 107 577 587 November 1958)

left side of the heart Such embolism can be eliminated by aspiration of air and replacement with saline after closure of ventricular septal defects

Clinical mortality rate from use of both types of oxygenators in 94 patients was 52% Of 5 patients with ventricular septal defect operated on with the bubble oxygenator, 3 died The stationary screen oxygenator was used to close ventricular septal defects in 44 patients, with 13 deaths Mortality in the rest of the patients, with transposition of great vessels, tetralogy of Fallot, atrioventricularis communis,

total anomalous pulmonary venous drainage and other complex defects, was 49%

Most deaths occurred early in the authors' experience but cannot be attributed solely to the bubble oxygenator which was used exclusively in the first 14 patients Most patients had severe pulmonary hypertension, severe cardiomegaly or intractable heart failure, 15% fell into the 48% mortality group (aged under 2, pulmonary artery pressure over 70% of aortic pressure) Elimination of air embolism and selection of better risk patients resulted in operative mortality of 30%, including patients with complex cardiac defects, such as tetralogy of Fallot

Three Safety Devices for Heart-Lung Machine. The most important single cause of pulmonary damage arising from use of a heart lung machine is overfilling of the pulmonary vascular bed To avoid this, Frederick Olmsted, Willem J Kolff and Donald B Effler[6] developed the following methods and devices (1) precise automatic control of blood volume in the oxygenator to prevent forward overloading of the lungs by changes in volume, (2) an open reservoir in the venous line, adjustable in siphon height, to preclude possibility of drawing the walls of the venae cavae into the openings of the cannulas, thereby occluding them, (3) a cannula in the left atrium to monitor left atrial pressure and to permit release of blood from the left atrium and thus avert build up of pressure and retrograde overfilling of the pulmonary vascular bed

The device for automatic control of the blood volume of the Kay and Cross oxygenator consists of electrodes with a sensing voltage of 15 volts with no more than 15 millionths of an ampere current Volume changes of less than 125 ml regulate the pumps This device was used during 30 cardiotomies with total heart-lung bypass After initial adjustments were made it worked smoothly Its efficiency was proved when, during a partial bypass, the arterial outflow line became blocked, with no changes in the blood volume of the patient Before each run the controls are checked by raising and lowering the blood level in the oxygenator from a buret With a 9 in oxygenator, a change of 75 ml (1 mm in height) blood will operate all control lights, with a 20 in

(6) Cleveland Clin Quart 25 169 176 July 1958

oxygenator, 125 ml will do so The automatic control can be switched to manual control instantly In case of power failure, hand cranks can be snapped into the pump rotors within 10 seconds

With the open venous reservoir, the vascular wall occlusion phenomenon of the venous cannulas did not occur With the left atrial cannula, increased pressure in the left atrium was avoided, but the possibility of its occurrence during perfusions was proved by temporary (15 seconds) clamping of the outlet tube from the atrium to the venous reservoir

Surface Tension Reducing Substances in Management of Coronary Air Embolism B Eiseman, B J Baxter and K Prachuabmoh[*] (Univ of Colorado) investigated the hydraulic forces pertaining to coronary air embolus By introducing surface tension depressant substances into the left ventricle of dogs simultaneously with injection of an otherwise 100% lethal dose of air, mortality has been decreased about 50%

Surface tension lowering agents diminish the lethal effect of intracardiac air when the two are injected simultaneously Theoretically, this could be due to the diminished resistance to slug flow resulting from depression of the surface tension of the liquid or to some factor reducing the amount of air that actually enters the coronary circulation The latter could result from reduction in the amount of intraventricular foam Whatever the mechanism, the effectiveness of the agent appears to be relative to its surface tension depressant activity Tween® 80, which diminishes the surface tension of blood but 6% is less effective than Dow Corning Antifoam A, which reduces blood surface tension 41% The latter is the most effective and least hemolytic substance, despite its particulate nature Even though 0 75 mg Dow Corning Antifoam B was injected into the left ventricle of 4 dogs with no visible short or long term neurologic effects an equally effective, but nonparticulate and nontoxic surface active substance would be preferable Because surface active agents assert their effect in minute concentrations a much smaller dose would probably be effective

In bubble oxygenators in which antifoam agents are used

( ) Ann Surg 149 374 380 March 1959

there is little doubt that small amounts of the debubbling agents are swept into the patient from the defoaming chamber Though there may be toxic effects from this material, these experiments suggest that such surface active agents also will minimize the toxicity of air emboli

Of similar significance is the bearing of the authors' experiments may have on the relative merits of perfusion pumps producing continuous rather than intermittent flow On theoretic grounds at least, continuous flow avoids impedance to fluid flow by air slugs hung up at points of constriction The high coronary perfusion pressure maintained while a patient is on the pump probably minimizes such effects of trapped air bubbles by overcoming resistance to flow and forcing the bubbles through the vascular network When perfusion is stopped, however, conditions for serious interference with flow may exist if air bubbles remain motionless within the blood vessels Ordinarily the first few beats of the heart after perfusion is ended are not forceful and may be insufficient to overcome the inertia and resistance to flow within the smaller vessels

Acidosis and Lacticacidemia in Extracorporeal Circulation: Significance of Perfusion Flow Rate and Relation to Preperfusion Respiratory Alkalosis were investigated by Martin S Litwin, Frederick G Panico, Carlos Rubini, Dwight E Harken and Francis D Moore[8] (Harvard Med School) The increased blood hydrogen ion concentration that occurs during low-flow pump oxygenator operation is the result of tissue hypoxia The plasma pH is proportional to the extracorporeal blood flow rate Plasma pH and plasma bicarbonate concentration are inversely proportional to the blood lactate concentration if differences due to ventilatory changes are eliminated Blood lactate concentration at the beginning and end of perfusion is inversely proportional to the per cent venous oxygen saturation Preoperative blood lactate concentration may be raised above normal by hyperventilation during anesthesia This in turn will contribute to increase in postoperative lactate concentration and hence lower the plasma bicarbonate and the pH

Clinically significant electrolyte shifts in the extracellular fluid in response to low flow pump oxygenator operation

(8) Ann Surg 149 188 199 February 1959

are (1) an increase in serum lactate concentration, and (2) a decrease in serum concentrations of potassium, calcium magnesium, bicarbonate and undetermined anionic buffers chiefly proteins, phosphates and sulfates The biochemical changes of respiratory alkalosis strikingly resemble the changes seen during low flow pump oxygenator operation

Preoperatively, care should be taken to insure the presence in each patient of adequate alkali reserve, particularly those treated with ammonium chloride and organic mercurial diuretics Since a marked depression in serum concentration of potassium occurs during perfusion, measurements should be carried out to insure adequate levels of this electrolyte Thus, development of cardiac arrhythmias may be prevented

Serum Electrolyte Observations Following Extracorporeal Circulation were made by Daniel M Baer, John J Osborn, Herbert A Perkins, Denis G Melrose Alan Norman and Frank Gerbode[9] (Stanford Univ) Only minor changes occur in serum electrolytes after open heart surgery using an extracorporeal circulation Although there is a slight acidosis and lowering of the carbon dioxide content it is only rarely necessary to correct these Because of the poor correlation of carbon dioxide content and blood pH, measurement of the former is not helpful in diagnosis of acidosis after surgery

Serum chloride, sodium and potassium show slight drops in serum concentration in the immediate postoperative period This probably results from dilution of blood electrolytes by intravenous fluids and water retention The decrease in the mean serum potassium suggests that potassium is not released in any large quantity by hemolysis of red cells or by tissue damage

There is some postperfusion increase in blood lactic acid After extracorporeal circulation, radiochromium studies have shown that as much as 88% of the patient's blood volume has come from donor blood and that, in effect an exchange transfusion has taken place Since the lactic acid content of the donor s blood may be 30 40% higher than that of the patient's blood, it is not surprising that there is a rise in lactate during perfusion However there may be other reasons for a rise in the blood lactic acid

(9) Am Heart J 56 652 657 November 1958

Clotting Deviations in Man during Cardiac Bypass: Fibrinolysis and Circulating Anticoagulant. Open heart surgery performed during hypothermia is sometimes accompanied by the fatal complications of hemorrhage and postoperative thrombosis The clotting process of human blood is not impaired during procedures performed on the heart under hypothermia However, the clotting mechanism was as complete at 28 as it was at 37 C and there was a tendency for hypercoagulability to develop, particularly following the rewarming phase Prolonged prothrombin time often became more prolonged under hypothermia Occasionally, a rare episode of severe hemorrhage has been encountered An occasional episode of clinical hemorrhage has also been noted after a cardiopulmonary bypass procedure

Kurt N von Kaulla and Henry Swan[1] (Univ of Colorado) investigated the over-all influence of extracorporeal circulation on the mechanism of clotting and fibrinolysis Marked increase of fibrinolytic activity and appearance of a circulating anticoagulant can considerably deviate the clotting mechanism during open heart surgery with the pump oxygenator This anticoagulant is not a reactivation of the administered heparin but a new anticoagulant produced by the body Fibrinolytic activity is enhanced by poor perfusion and a low pH of the blood Neither fibrinolysis nor circulating anticoagulant itself necessarily produces hemorrhage, but the combination is dangerous

Hematologic Problems Associated with Use of Extracorporeal Circulation for Cardiovascular Surgery are considered by Ivan W Brown, Jr, and Wirt W Smith[2] (Duke Univ) Postperfusion bleeding tendency is occurring less frequently as more experience is gained and less traumatic heart-lung machines are developed, but it is still a major factor limiting the duration of safe cardiopulmonary bypass Though multiple factors may be involved, available evidence implicates activation of systemic coagulation through liberation of thromboplastic substances in the extracorporeal heart-lung circuit

Blood platelets are consistently decreased during and after most extracorporeal perfusions Though usually tem-

(1) J Thoracic Surg 36 519 530 October 1958
(2) Ann Int Med 49 1035 1048 November 1958

porary, thrombocytopenia may persist 2-4 days Unless perfusion is unduly prolonged, the platelet level rarely drops to hemorrhagic levels White blood cell counts are also temporarily depressed Mechanical destruction of red blood cells during perfusion, though occurring to some degree with all types of heart lung machines, is no longer a serious problem with the most modern pumps and oxygenators Ordinarily, those red cells which survive the perfusion period intact exhibit normal in vivo survival for at least 2-3 weeks, sometimes longer Certain susceptible recipients of donor blood which has been exposed to an artificial heart-lung circuit may destroy this blood, presumably through antibody formation to certain lesser antigenic blood group factors, after varying periods of initial normal red cell survival have been allowed Whether this indicates that exposure of blood to an extracorporeal circuit enhances the antigenicity of certain blood group factors or whether this phenomenon occurs with equal frequency among recipients of large transfusions of unexposed blood is yet to be determined

It is important to maintain low blood dilution, near-normal pH and normal electrolyte pattern, particularly of ionized calcium, of the donor blood These special blood requirements for extracorporeal circulation present difficult problems for blood banks A possible solution to some is suggested through use of a new anticoagulant-preservative mixture now under study

This solution, called Ed-glu gate Magnesium contains sodium EDTA, sodium gluconate, glucose and magnesium chloride Sodium EDTA replaces the usual sodium citrate as the initial anticoagulant The small amount of sodium gluconate added to the glucose enhances preservation of red cells should the blood not be used for extracorporeal circulation but instead be stored longer for routine use The small amount of magnesium chloride is added to inhibit inactivation of factor V by EDTA Blood for extracorporeal circulation may be stored in this mixture for 3-5 days before operation with excellent platelet preservation

► [Hematologic complications of open heart surgery occur rarely if duration of artificial perfusion is kept to a minimum The principal problem which remains in our open heart program is blood procurement and storage Experimental studies done by Abbott in our laboratories with Brown's Ed glu gate have not been encouraging in regard to prolonged storage of

blood for priming the pump oxygenator Thus, we still use heparin glucose as the anticoagulant preservative and use the blood within 24 hours of procurement —Ed]

Observed Central Nervous System Responses during Experimental Employment of Various Pump Oxygenators Guy Owens, Jesse E Adams, Royce E Dawson, Edward M Lance, John L Sawyers and H William Scott, Jr[3] (Vanderbilt Univ) did EEG studies during cardiopulmonary bypass in 150 dogs and 23 patients, using microbubble, macrobubble and filming oxygenators The EEG proved to be a reliable, sensitive indicator of the adequacy of cerebral perfusion by oxygenated blood during bypass procedures with pump oxygenators Observations during use of micro and macrobubble oxygenators consistently showed undesirable alterations in the EEG that apparently reflect suboptimal cerebral perfusion In contrast, recordings during use of the filming oxygenator with higher flow rates showed little or no deviation from the base line patterns of the anesthetized subject

Prolonged isoelectric EEG tracings during and/or after bypass procedures are accompanied by poor chances for survival No convulsive phenomena were observed during bypass with any oxygenating device used in this study During bypass EEG activity that can fluctuate freely with changes in anesthetic concentrations is most desirable This was best accomplished by maintenance of flow rates sufficient to allow arterial pressure to remain stable at 90-120 mm Hg Low flows, however well tolerated for short periods, apparently reduce tissue reserves and thereby increase the hazards of only momentary additional circulatory insults The EEG evidence of impaired cerebral function with the filming oxygenator has occurred only during the resumption of cardiac circulatory efforts immediately after conclusion of the bypass procedure It is possible and important to correct EEG abnormalities promptly at this point by restoring adequate circulation by return to the pump oxygenator or other means of support In this connection, the EEG becomes a valuable aid in "titrating" the physiologic tolerance to transitory periods of hypotension during resumption of cardiac circulatory efforts

The EEG obviously cannot pinpoint intrinsic deficiencies in an oxygenating and/or circulating unit Though ap

(3) Surgery 44 240 254 July 1958

parently accurately reflecting the adequacy of cerebral perfusion during bypass, it provides no definite assurance of the adequacy of perfusion of other vital organs Large quantities of air injected into the carotid artery of dogs produced minimal EEG changes, but death without recovery of consciousness commonly resulted It would therefore be difficult to interpret the EEG changes encountered when the micro and macrobubble oxygenating devices were used, as evidence of cerebral air embolism Experimental evidence by Maloney and his associates, however, indicates that air embolism is produced when the macrobubble device has been used

Cerebral Blood Flow, Metabolism and Brain Volume in Extracorporeal Circulation was investigated by M Martin Halley, Keith Reemtsma and Oscar Creech, Jr[4] (Tulane Univ) Among the complications of extracorporeal circulation are neurologic disturbances, varying in severity from transient disorientation to progressive lethargy, coma and death Factors which have been mentioned in the etiology of this syndrome include hypoxia, caval obstruction from malfunctioning catheters and cerebral embolism of bubbles fibrin and silicone Lack of knowledge of cerebral metabolism during cardiopulmonary bypass has made interpretation of such sequelae difficult

The authors found that cerebral blood flow during extracorporeal circulation was directly proportional to the mean systemic blood pressure and, at times, varied widely with perfusion rate At low rates of cerebral blood flow, a linear flow limited decrease in cerebral oxygen consumption was observed However, decreased cerebral oxygen consumption independent of blood flow, was also found This phenomenon resulting from a narrowed arteriovenous oxygen difference due to increased venous oxygen content was most marked at high flow rates Where it occurred at lower flow rates the effect was somewhat obscured by lower venous oxygen content, resulting from increased extraction at the lower rates of cerebral blood flow Explanation of this phenomenon must center around three possibilities altered tissue metabolism impaired diffusion of oxygen to tissue or uneven regional distribution of cerebral flow

Changes in arteriovenous oxygen differences and in oxygen

(4) *J Thoracic Surg* 36 506 518 October 1958

consumption during hypothermia show a comparable pattern Although temperature of the animals is continually monitored in the rectus muscle and although the nonflow-limited decrease in cerebral oxygen consumption occurs in preparations with stable, rising or falling temperatures, the greater susceptibility of the brain to temperature changes raises the possibility of disproportionate cooling of this organ during extracorporeal circulation

One other factor to be considered is the abnormally high P_{O_2}, which raises the question of oxygen intoxication as a factor in decreased cerebral oxygen consumption, although this remains questionably significant

Lactic acid, pyruvic acid and lactate pyruvate ratios show no significant change from control values during extracorporeal circulation

Superior vena caval and cerebrospinal fluid pressures vary together Marked elevations of superior caval pressure, at times with apparently adequate perfusion rates and blood pressure were noted in 4 experiments About half the dogs killed shortly after extracorporeal circulation showed increased brain volume, including 4 with inadequate superior caval outflow Increased brain volume may represent a non specific response in many instances, since it also occurred after procedures not involving extracorporeal circulation in dogs showing no evidence of central nervous system damage

Experimental and Clinical Studies of Controlled Hypothermia Rapidly Produced and Corrected by Blood Heat Exchanger during Extracorporeal Circulation In open heart surgery extracorporeal circulation has been combined with hypothermia The standard methods for the latter have several disadvantages, such as the time required for cooling and rewarming lengthening of anesthesia time, poor control and downward drift of temperature Therefore, Ivan W Brown, Jr Wirt W Smith, W Glenn Young Jr, and W C Sealy[5] (Duke Univ) developed the following technic

PROCEDURE—A heat exchanger assembly consisting of an automatic thermostatic water mixing valve heat exchange unit and bubble trap filter unit—all mounted on a pole type floor stand—is used The automatic thermostatic water mixing valve blends hot and cold tap water carried to it by ordinary garden hoses The water entering the heat exchange unit is automatically and precisely thermoregu

(5) J Thoracic Surg 36 497 504 October 1958

lated, regardless of fluctuations in supply water temperature or pressure, and flows through the exchanger at a rate of 3 gal./minute. The design and construction of the all stainless exchanger unit are based specifically on the physical properties and exacting requirements of human blood. The exchanger, although it has a blood volume of only 175 cc., nevertheless has a very high efficiency of heat transfer. After flowing through the exchanger unit, the blood passes into an efficient bubble trap filter and thence into the artery. An autoclavable thermistor probe in the bottom of the bubble trap continuously monitors the inflow blood temperature. The heat exchanger assembly may be used with any type of extracorporeal circuit and is interposed in the inflow line between the heart lung machine and the cannulated artery.

In dogs, the heart, liver and kidneys cool and rewarm most rapidly and at essentially the same rate when hypothermia is produced and corrected by this method. The brain and midesophagus cool and rewarm at only a slightly slower rate. The midesophagus temperature most closely reflected the temperatures of the other vital organs. In both animals and man, it was possible to lower the temperature from 37 to 30 C. in a few minutes and to maintain evenly a chosen hypothermic temperature level to within 0.5 C. Rewarming from 30 to 35 C. was accomplished at a rate only slightly slower than that of cooling. Oxygen saturation values of venous blood from the brain, right heart, liver, kidney and leg in the hypothermic dog, maintained by a pump oxygenator, showed good relative correlation with the mixed venous blood oxygen values.

Reduced Metabolism by Means of Hypothermia and Low Flow Pump Oxygenator was studied by E. Converse Peirce II, C. Harwell Dabbs, William K. Rogers, Freeman L. Rawson and Ruby Tompkins[6] (Knoxville, Tenn.) in dogs. Extracorporeal blood flows of about 25% of the basal cardiac output resulted in hypoxia and metabolic acidosis when used at normal temperatures. Cooling the blood just before returning it to the body, easily produced pronounced reduction in the temperature of the heart, brain, liver and kidney, with great economy in heat transfer because the bulk of the animal, consisting of skin, muscle and bone, is cooled much more slowly. The result is marked oxygen saving, due to the direct antimetabolic effect of the cooling. Metabolic acidosis can be avoided and to date no irreversible effects of

(6) Surg. Gynec. & Obst. 107: 339-352, September, 1958.

the cooling have been seen Warming is so greatly facilitated by the heat stored in the nonvital areas that it is not necessary to warm the blood returning from the extracorporeal circuit

The following advantages of the procedure were noted (1) A combination of hypothermia and pump oxygenator permits use of a small and simple apparatus and low blood flow rates (2) Since flow rates are low, cannulation procedures may be simplified, and peripheral vessels may be used routinely (3) As only a small caloric exchange is required to produce a large decrease in oxygen demand, the method is much more efficient than immersion hypothermia (4) The lowered total extracorporeal flow should result in decrease in total damage to the blood passing through the pump-oxygenator (5) In extremely sick or moribund patients, it should be possible to assist the failing heart without, or before, thoracotomy and to do so with small and perhaps readily transportable equipment

The following possible disadvantages exist (1) Cold per se may produce some qualitative, deleterious changes in cellular metabolism (2) Low flow rates of blood, even with the metabolic protection of hypothermia, may lead to inadequate oxygenation of some organs or tissues or to spotty distribution of blood within any particular organ (3) Warming of blood may lead to liberation of oxygen bubbles since affinity of blood for oxygen decreases as temperature rises Such liberation becomes more likely with the high oxygen tension commonly found in most oxygenator circuits (4) Monitoring with the EEG is a usual practice in heart lung work, but with hypothermia it is probably less meaningful (5) Cardiac arrhythmias, especially ventricular fibrillation, have been associated with simple hypothermia and might be expected to constitute a problem with the authors' method

Certain Blood Changes in Patients Undergoing Extracorporeal Circulation Analysis of 350 Perfusions Richard A DeWall, David M Long, Sharon J Gemmill and C Walton Lillehei[7] (Univ of Minnesota) analyzed the perfusion and hospital records of 350 total cardiopulmonary bypass procedures, using the helix reservoir bubble oxygenator and Sigmamotor pump These perfusions were done in conjunc-

(7) J Thoracic Surg 37 325 333 March 1959

tion with direct-vision corrective intracardiac surgical procedures.

Changes induced in the blood as a result of total body perfusion are a function of time. Patients with cyanotic heart disease had lesions that required generally more perfusion time to be properly corrected than patients with acyanotic heart disease. Therefore, the perfusion times of these two groups were calculated separately. The duration of the perfusions for the acyanotic patients averaged about 40% less time than that required for repair of the cyanotic patients The plasma hemoglobin levels for the acyanotic patients were about 34% lower than those observed for the cyanotic patients; however, the cyanotic patients had longer perfusions during which plasma hemoglobin could be formed. The rate of plasma hemoglobin formation was actually a little less in cyanotic patients than in acyanotic. Cyanotic patients have extensive bronchial collaterals and usually greater total cardiotomy loss during the procedure than acyanotic persons.

With experience, less blood was lost from the cardiotomy and perfusion system than during earlier bypass procedures. Despite this, the levels of plasma hemoglobin measured remained about constant. This consistency was true regardless of the arterial pump outputs required. Most of the hemolysis observed was probably produced by the cardiotomy suction system, which returns cardiotomy losses to the perfusion apparatus. However, the percentage that can be attributed to this is difficult to estimate.

The platelet counts decreased after perfusion, but never to a degree to cause bleeding. A mild postoperative decrease in hemoglobin was observed during the first 3 weeks after surgery. Mean pH values at the end of the perfusion were within normal range.

Syndrome of Left Ventricular-Right Atrial Shunt: Successful Surgical Repair of Defect in Five Cases, with Observation of Bradycardia on Closure is described by Frank Gerbode, Herbert Hultgren, Denis Melrose and John Osborn[8] (Stanford Univ.). *In left ventricular-right atrial shunt,* three general varieties of communication should be considered: (1) fusion of the septal leaflet of the tricuspid valve to

(8) *Ann. Surg.* 148.433-446, September 1958.

foramen ovale into the left atrium If only a left ventricular right atrial shunt is present, the left atrial pressure will be higher than right atrial pressure by 5 mm Hg or more If an atrial septal defect is present, these pressures will be equal, unless the defect is small Use of the phonocatheter has demonstrated that in atrial septal defect the murmur is maximal at the pulmonary valve, but is faint in the right ventricle and atrium In a left ventricular right atrial shunt the murmur should be maximal in the right atrium because this was the location of the thrill palpable at surgery in the patients described in this study

Recognition of this condition is important for two reasons (1) Erroneous diagnosis of an atrial septal defect may lead to an unsuccessful attempt to repair the defect by a closed technic Correct preoperative diagnosis will indicate open repair of the lesion using extracorporeal circulation which is the procedure of choice (2) The severe symptoms and clinical picture may suggest a complicated lesion with a poor prognosis, such as an A-V communis with congestive failure, and surgery may not be attempted Repair of the lesion, however is relatively simple, using the open technic through an incision in the right atrium, and functional results are excellent

Surgical Treatment of Partial and Total Anomalous Pulmonary Venous Connections J L Ehrenhaft, E O Theilen and Montague S Lawrence[9] (State Univ of Iowa) observed 11 patients with partial anomalous venous connections of the right superior pulmonary vein or of the entire right lung 10 of whom had associated interatrial septal defects Several *methods of correction were used*

In one method the atrial septal defect was used in repair without closure of the defect in the septum itself Rows of sutures were placed through the anterior and posterior walls of the atrium from the orifice of the anomalous veins to and around the margin of the atrial defect to form a small chamber between the orifice of the anomalous pulmonary vein and the atrial defect The pulmonary venous blood was shunted directly into the left atrium Admixture with systemic venous blood was excluded Superior caval flow continued uninterruptedly into the right atrium If the pulmonary veins en

(9) Ann Surg 148 249 258 August 1958

tered the superior vena cava, one of the rows of sutures was run from the upper margin of the orifice of the pulmonary vein down the superior cava and around the margin of the atrial defect This effectively divided part of the superior cava into two channels and in a sense split the superior cava This procedure, done in 3 patients, was successful and uncomplicated in 2 In 1 patient, a modified atrioseptopexy resulted in complete superior vena caval obstruction in the postoperative period

When the interatrial septal defect was extremely high or the superior vena cava relatively narrow, a modified atrioseptopexy was done, shunting the pulmonary venous return and temporarily the superior vena caval return through the interatrial septal defect The superior vena cava was transected between clamps above the site of entrance of the pulmonary veins The lowermost portion of the superior vena cava was used as a channel for the pulmonary venous return while the upper segment of the transected vena cava was reimplanted into the right atrial appendage Thus, both venous streams were separated without obstruction of the superior vena cava or of the pulmonary veins This type of repair was used in 4 patients

In 1 patient, all pulmonary veins from the right lung entered the inferior vena cava Correction of this defect was done by open atriotomy and correction of the associated anomaly under direct vision In 1 patient, with an ostium primum defect, anomalous veins entered the right atrium Correction of the defect was attempted bv open cardiotomy under hypothermia but was abandoned because of the size of the defect In another patient, a large interatrial septal defect was closed, but the anomalous pulmonary venous drainage from the right upper lobe which entered the superior vena cava above the level of the azygos vein was not corrected

At exploration, 1 patient showed anomalous pulmonary venous connections of the entire right lung and no interatrial septal defect 6 separate pulmonary veins entered the superior vena cava and the right atrium along the entire lateral wall This anomaly could not be corrected by anastomosis to the left atrium Temporary occlusion of the right pulmonary artery immediately reduced the left-to-right shunt, and

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heart size decreased Subsequently, a right pneumonectomy was done There were no deaths in this series

Total anomalous venous return was corrected completely and successfully in 1 patient Anastomosis of the posterior pulmonary venous chamber with the left atrium, interruption of the left superior vena cava and closure of the inter atrial septal defect re-established normal pathways of blood flow

► [The technic described by Cooley (see 1958-59 YEAR BOOK, p 204) for treatment of total anomalous pulmonary venous connections in which the pump oxygenator is used provides the most satisfactory method of surgical repair He now has 9 consecutive cases of supracardiac type corrections of the entire pulmonary venous drainage system with successful complete repair in one stage Cardiopulmonary bypass should be available for partial anomalies also to connect the intracardiac septal defect simultaneously —Ed]

Surgical Treatment of 35 Cases of Drainage of Pulmonary Veins to Right Side of Heart, representing 38% of 92 treated during 9 years for anomalous venous return or atrial septal defect, is described by Henry T Bahnson, Frank C Spencer and Catherine A Neill[1] (Johns Hopkins Univ)

Partial anomalous drainage into the right atrium can be readily treated with modification of the technics used in repair of simple atrial septal defects The authors used hypothermia, inflow occlusion and suture, under direct vision, of the anterior rim of the defect to the right of the pulmonary veins When veins enter the right auricle just above or below the defect and adjacent to the intact septum, incision of the septum is required posteriorly, adjacent to the orifice of the anomalous vein This flap of septum may then be sutured anterior and to the right of the pulmonary veins *In 1 patient*, the rim of the septal defect was unusually far to the left and all right and left pulmonary veins drained into the right atrium to the right side of this septal rim After incision to enlarge the defect, the anterior rim of septum could be sutured to the right of the pulmonary veins, thus completely correcting the totally anomalous return (Fig 44) Including this patient, 10 had an atrial septal defect with one or more pulmonary veins draining directly into the right atrium in 3 the superior and middle lobe veins were the only anomalous ones, in 3, the inferior vein alone, and in 4, all right pulmonary veins entered the right atrium Two of the 10 died of

(1) J Thoracic Surg 36 777 802 December 1958

conditions probably unrelated to the anomalous pulmonary venous return.

Fifteen patients were treated with anomalous drainage into the right superior vena cava, in 5 of whom all pulmonary

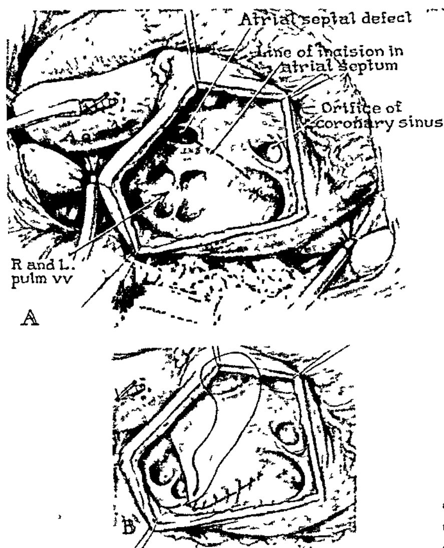


Fig 44—Total anomaly of pulmonary veins to right of atrial septum with 1-cm foramen ovale, in patient, 15 Complete repair was effected by incision of septum and suture to right atrial wall, *B* (Courtesy of Bahnson, H T, *et al* J Thoracic Surg 36 777 802, December, 1958)

veins drained anomalously Good results were obtained in 11 patients treated by partition of the vena cava, with the pulmonary venous blood directed to the left side through the atrial defect, which was then closed under direct vision with inflow occlusion and hypothermia.

Total anomalous pulmonary venous drainage into the cor-

onary sinus was seen in 3 patients In all, the anomaly could be corrected under direct vision by excision of the partition between the coronary sinus and left atrium and closure of the single atrial defect, in essence, converting the double barreled opening into a single one, the coronary sinus orifice being unusually large Two patients obtained good results In another patient, an infant, the true state of the anomaly was not appreciated before operation and attempt to repair the atrial defect under hypothermia resulted in cardiac impairment that precluded a second occlusion for the repair, the child died subsequently

Seven patients were operated on for the anomaly in which all pulmonary veins drain into the persistent left superior vena cava In 4, attempt was made to anastomose the left atrium or its appendage to the left superior vena cava, with subsequent partial or complete obstruction of the left superior vena cava craniad to the anastomosis, all died of pulmonary edema or insufficient blood flow to maintain systemic arterial pressure In 3, repair was attempted by diversion of the right superior vena cava through the septal defect to the left atrium, with ligation of the systemic venous tributaries to the anomalous venous trunk In 1, an infant, the repair, done with inflow occlusion under hypothermia, failed because of improper suturing Another infant in severe failure died soon after an operation that had been considerably prolonged because of oozing Pulmonary edema was transiently present, probably due to overtransfusion In 1 patient, however, an adult with cardiac enlargement and progressively limited activity, the procedure was successful The superior vena cava was cannulated through the right innominate vein, which was later divided, and the inferior cava through the nearby atrial wall Blood from the venae cavae was led through the cardiopulmonary bypass and returned to a femoral artery An Ivalon patch was sutured to direct the superior caval flow, with the entire pulmonary drainage, into the left atrium through the septal defect The azygos vein was ligated, thus leaving only the left innominate vein draining, with the common pulmonary trunk to the left

Rupture of Aneurysms of Valsalva's Sinus into Cardiac Cavities Ch Dubost, Ph Blondeau and A Piwnica[2] (Paris)

(2) J chir 75 539 565 May 1958

describe a typical rupture into the right auricle of a congenital aneurysm of Valsalva's sinus, which was successfully repaired by operation

Woman 36, had rapidly progressing signs of cardiac insufficiency

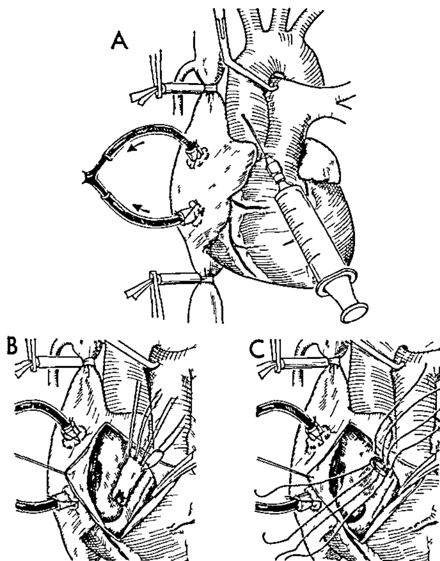


Fig 45—Repair of rupture of aneurysm of Valsalva's sinus *A* mounting of extracorporeal circulation and cardiac arrest produced by potassium citrate *B* and *C* resection of sac and suture of fistula approached across right auricle (Courtesy of Dubost C *et al* J chir 75 539 565 May 1958)

after sudden onset of symptoms 2 months before Operation was considered urgent It was performed with extracorporeal circulation by a Melrose apparatus Cardiac arrest was produced by injection of potassium citrate Extracorporeal circulation lasted 19 minutes and cardiac arrest 12 minutes Bilateral thoracotomy was performed, passing through the 4th intercostal space on the left and the 3d on the

right, with horizontal sternotomy Exploration confirmed the presence of an aneurysm of the sinus of Valsalva, ruptured into the right auricle The base of the aneurysmal sac was sutured with 2 trans fixing sutures (Fig 45), the aneurysmal sac was resected, and closure was effected over points of pressure at the base The auricle was closed, the aortic clamp was lifted, and the heart immediately started in sinus rhythm, the thrill having completely disppeared The heart functioned efficiently, and peripheral arterial tension was 110/80 Examination 4 months after operation showed that the patient was in excellent condition subjectively and objectively

This is the fifteenth reported case of this type in which reparative surgery has been performed Operations were successful in 8 patients, 1 of whom was operated on under hypothermia and 7 with extracorporeal circulation The percentage of successes has increased considerably since the adoption of extracorporeal circulation

Congenital Aortic Stenosis: Clinical and Hemodynamic Findings, Surgical Technic and Results of Operation in 30 patients are presented by Andrew G Morrow, Edward H Sharp and Eugene Braunwald[3] (Nat'l Inst of Health) Eighteen patients were operated on In the first 4, a closed transaortic or transventricular operation was used Operation under direct vision by general hypothermia was carried out in the next 11 and the last 3 operations were performed with the aid of extracorporeal circulation and elective cardiac arrest with the patients at normal temperature In the management of patients undergoing general hypothermia, all were digitalized preoperatively The patients were cooled by immersion to an ultimate esophageal temperature of 30-32 C For operation under direct vision at normal temperature, a Kay-Cross oxygenator with occlusive roller pumps was used

Technic—With hypothermia or perfusion, a complete median sternotomy is made and the right pleural space and pericardium are opened wide Tapes are passed about the superior and inferior venae cavae within the pericardium and the entire ascending aorta is freed from pericardium and adventitia and separated from the pulmonary artery Dissection is carried as close as possible to the aortic annulus and facilitated by retraction of the right atrial appendage and fat pad in the atrioventricular groove Care must be taken to avoid injury to the right coronary artery A partially occluding clamp is applied to the anterolateral wall of the aorta, excluding a segment 2-3 cm long Incision is made in the excluded aorta and stay sutures are placed The venae cavae are occluded (hypothermia) or cannulated and oc

(3) Circ lation 18 1091 1104 December 1958

cluded (extracorporeal circulation), and the aorta is cross clamped just below the innominate artery With perfusion, the heart is stopped by injection of 2 5% potassium citrate in blood into the occluded aorta The aortic incision is opened, its margins are carefully retracted and residual blood is aspirated from the aorta and left ventricle The valve is easily visualized (Fig 46) If valvular stenosis is present, commissures are carefully identified and divided in turn with scissors (Fig 47, *B*) The commissures are cut to within a few millimeters of the aortic wall and their division is completed with a Brock or Bailey dilator If the valve is not stenotic, the leaflets are grasped and retracted by an assistant Subvalvular obstruction may then be

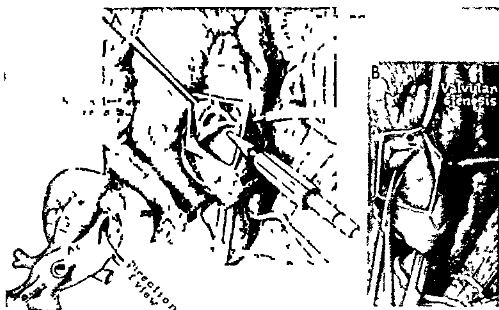


Fig 46—Subvalvular (*A*) and valvular (*B*) congenital aortic stenosis as observed in course of operation under direct vision (Courtesy of Morrow A. G *et al* Circulation 18 1091 1104 December 1958)

cut, dilated or resected with a Brock infundibular punch (Fig 47, *A*) After obstruction has been relieved, residual air is flushed from the left ventricle and aorta, the partially occluding clamp is reapplied, the cross clamp removed and the aortic incision closed with continuous suture Inflow occlusion varied from 2 to 5 minutes with hypothermia Measurements of the valve gradient and cardiac output have ordinarily been made before and after valvulotomy

Of the 18 patients, 15 are alive and free from cardiovascular symptoms One died of irreversible ventricular fibrillation after inflow occlusion In 1, pseudomonas septicemia developed and he died 5 weeks postoperatively At autopsy, infected granulation tissue was found in the aortic suture line One patient died 10 days postoperatively of massive intrathoracic hemorrhage after use of heparin and Dicumarol® for femoral thrombophlebitis No bleeding point could be

identified at autopsy, the aortic incision was well healed One patient had recurrent right pleural effusions for several months, and in 1, operated on by the closed transaortic route epileptiform seizures developed 6 months after opera-



Fig 47 —Operative management of subvalvular (*A*) and valvular (*B*) obstructions under direct vision Subvalvular membrane exposed by retraction of leaflets and is cut and dilated (Courtesy of Morrow A G *et al* Circulation 18 1091 1104 December 1958)

tion One patient showed ECG configuration of left bundle branch block Although most patients who survived the operation have had gratifying clinical results, postoperative hemodynamic studies in all but 5 indicate that some residual stenosis exists

Aortic Commissurotomy under Direct Vision William S Dye, Ormand C Julian, Hushang Javid, William J Grove Donald E Morehead and Oldrich Prec[4] (Chicago) report results in 23 patients aged 5 56, operated on for aortic stenosis under direct vision with use of hypothermia with inflow occlusion All had significant cardiac symptoms placing them in class III or class IV except 2 of 5 with congenital stenosis Of these 5 3 had valvular congenital aortic and 2 subvalvular aortic stenosis In the other 18 the lesion was acquired calcific aortic stenosis

In the 5 with congenital stenosis, results were uniformly good but 2 had mild symptoms so that the clinical result was not easily appraised There were no deaths in this group and all tolerated surgery well

Of the 18 with acquired aortic stenosis, 3 died during surgery or in the immediate postoperative phase One operative death occurred in the only patient who showed unsuspected

(4) Ann Surg 148 469 478 September 1958

significant aortic regurgitation instead of stenosis. Coronary air embolism produced ventricular fibrillation which could not be corrected. One patient died 6 hours after operation of pulmonary edema secondary to overtransfusion. The other died on the 14th postoperative day of pulmonary embolus. This was the only patient who had ventricular fibrillation during surgery. Another patient died 3 months after surgery. The immediate postoperative period was uneventful, and some clinical improvement was noted; the cause of death is not known. Of the other 14 patients with acquired aortic stenosis, 9 showed significant improvement clinically; 2 were slightly improved and 3 were unchanged. Follow-up was 3 months to 2½ years.

Comparison of pre- and postoperative ECG's and x-rays is disappointing in establishing objective evidence of improvement as a result of commissurotomy, even in patients who show definite clinical improvement, although such evidence was obtained in a few. Long-term results of aortic commissurotomy have not been defined. The nature of the acquired lesion makes it likely that the only real solution is removal of the stenotic valve, with replacement by a substitute. Results in congenital aortic stenosis are promising.

Experimental Results with Prosthetic Aortic Valve, implanted in the ascending aorta of 51 dogs, are reported by Benson B. Roe, John W. Owsley and Peter C. Boudoures[5] (Univ. of California). To be effective, a valve should be me-

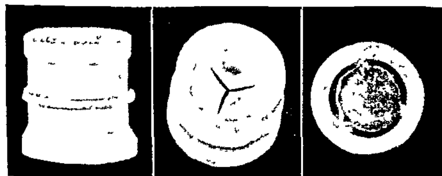


Fig. 48.—Three views of current model valve. Flanged ends act as gaskets to prevent currents between prosthesis and aortic wall. (Courtesy of Roe, B. B., et al.: J. Thoracic Surg. 36:563-570, October, 1958.)

chanically efficient. It should provide minimal resistance to forward flow and effectively prevent retrograde flow, pref-

(5) J. Thoracic Surg. 36:563-570, October, 1958.

eiably without crushing action. It should be designed to af-ford safe and reliable fixation, so as not to impede the func-tion of other valves, not to occlude the coronary ostia and not to disturb normal fluid dynamics. The valve should be composed of a nontoxic, noncarcinogenic material which pre-

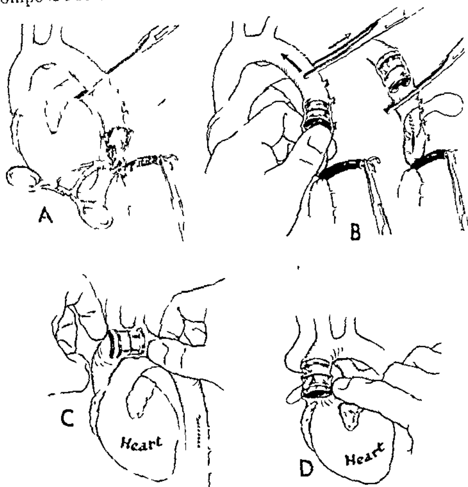


Fig 49—Insertion of prosthetic flexible aortic valve *A*, insertion of folded pro thesis through distal aortotomy Intercostal branches are occluded with dura clip *B*, proximal clamp is released as prosthesis is extruded upward, bleeding is controlle by thumb pressure Clamp is reapplied and aortotomy is sutured *C*, prosthesis pushed across aortic arch Finger pressure at brachiocephalic take-off starts downwa course at leading edge *D*, valve in proper position is sutured through aortic wa into fixation ring (Courtesy of Roe, B. B, *et al*: J. Thoracic Surg 36 363 5 October, 1958)

cludes the erosion of tissues and superficial clotting and able to retain its tensile strength indefinitely in the bloc stream.

The valve designed by the authors fulfills these conditio It is made of a monomolecular silicone and is cast und pressure in a precision die. The three cone-shaped, thin, fle

ible cusps of the valve retreat readily and produce minimal resistance to systolic flow. There is little turbulence at the edges or behind the cusps. The smooth, nonwettable surface effectively prevents clotting (Fig. 48). To place the prosthesis in position, it is folded and inserted into the occluded descending thoracic aorta, pushed in a retrograde direction over the aortic arch and pushed downward into the ascending aorta (Fig. 49).

Experimental results have been excellent. The valve appears to be physiologically tolerated and hemodynamically effective. The clinical possibilities are evident, though the technic has not yet been tried in man.

Direct Approaches for Treatment of Aortic Insufficiency are evaluated by Charles A. Hufnagel[6] (Georgetown Univ.). Most aortic lesions require reduction in the size of the annu-

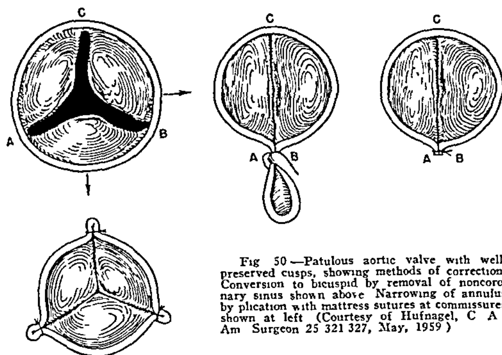


Fig 50.—Patulous aortic valve with well preserved cusps, showing methods of correction Conversion to bicuspid by removal of noncoronary sinus shown above Narrowing of annulus by plication with mattress sutures at commissures shown at left (Courtesy of Hufnagel, C A · Am Surgeon 25 321 327, May, 1959)

lus, addition of substance to a cusp, replacement of an entire cusp or total valve substitution. Reduction in size can be done by plication.

TECHNIC.—With temporary inflow occlusion, it is possible to place a clamp that includes only the aortic wall of the noncoronary cusp. This maneuver may be used to reduce the distance between the two commissures of this leaflet or to bring together completely the com-

(6) Am Surgeon 25 321-327, May, 1959

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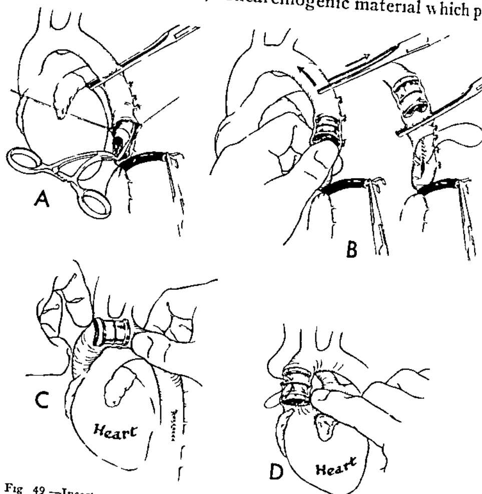


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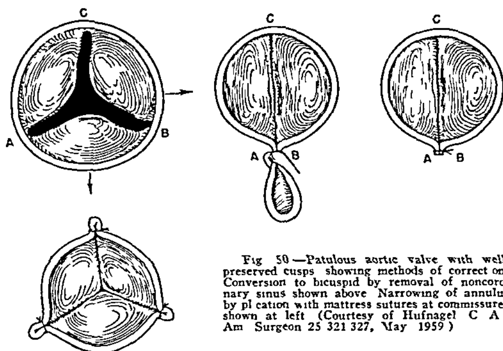


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(6) Am Surgeon 25 321 327 May 1959

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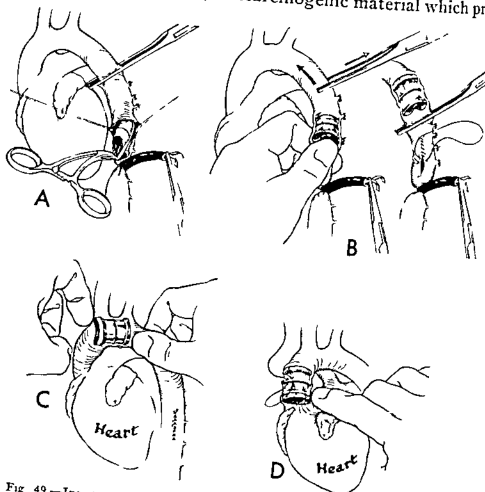


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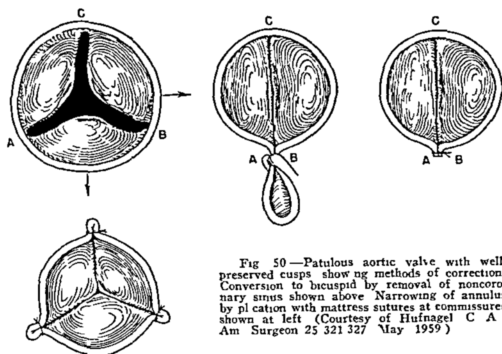


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(6) Am Surgeon 25 321 327 May 1959

missures of the other two cusps to form a bicuspid valve By inserting a finger in the aorta, the valve cusp can be brought into the clamp for excision If pressures in the femoral arteries are monitored and the insufficiency is well controlled, diastolic pressure rises immediately to normal levels Sutures may then be placed in the aortic root at this area and the excess aortic wall removed (Fig 50) This indirect procedure, although associated with considerable technical difficulty, has been satisfactory in restoring normal dynamics and in eliminating the leakage when simple annular dilation has been the cause of the insufficiency If sutures are not taken directly through the commissural zones, but are permitted to emerge through the lower portion of the thin walled aorta, the high pressure in this area can result in cutting through of sutures in the lower aspect of the

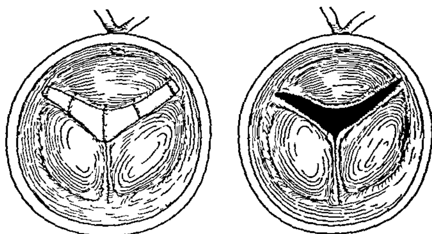


Fig 51 —Addition of substance to scarred leaflet (Courtesy of Hufnagel C A Am Surgeon 25 321 327, May, 1959)

sinus of Valsalva Serious hemorrhage can result unless these sutures are reinforced with small patches of a buttressing material

Some forms of aortic insufficiency show rather pronounced stiffening of one or more leaflets and curling of such leaflets If this deformity is not excessive, the gap left by the shortened leaflet or leaflets can be closed by adding a small amount of additional substance sutured to the edge of the leaflet (Fig 51) Pledgets of Ivalon have been used for this purpose, held in place by interrupted sutures to the leaflets Similar additions to the cusp can be made to restore its ability to coapt, using Dacron or Teflon cloth, provided these are anchored to the leaflet and commissures as well Single cusps have been constructed of plastic materials A small flap of material is molded to conform to the contour of the aortic wall at the edge of the artificial leaflet When blood fills the cusp in diastole, this flap follows the movement of the aortic root to provide additional sealing

Experimental total valve replacement has also been made in several ways A tricuspid valve has been devised that incorporates the features of the cusp, with all three cusps mounted as a single unit If a small margin of each of the diseased leaflets is left at the base a tricuspid valve can be fixed at a point just above the remaining commis

sures and the lower portions of the old valve leaflets used for seating. Suture of the superior portions of the commissures then gives excellent fixation.

Surgical Treatment of Aortic Insufficiency by Open Plastic Revision of Tricuspid Aortic Valve to Bicuspid Valve *was studied in 20 dogs by* Joseph J. Garamella, James G. Andersen and Reuben Oropeza[7] (Minneapolis).

TECHNIC.—The dogs were anesthetized with Pentothal® sodium intravenously and intubated. Pulmonary ventilation with room air was controlled with a mechanical intermittently positive pressure apparatus. Blood pressure was monitored by a cannula in the left femoral artery. The right carotid artery was exposed, ligated distally and cannulated proximally with a 14 F. catheter for perfusion.

Right thoracotomy was performed through the 4th or 5th interspace. Umbilical tapes were passed around the superior and inferior venae cavae and ascending aortic arch. Animals were heparinized 1.5 mg./kg. Catheters were passed into the venae cavae and connected to tubing in continuity with the extracorporeal pump-oxygenator, bubbler type (DeWall). Perfusion rates were 35-40 cc./kg./minute. Perfusion times were 20-42 minutes.

The pump-oxygenator was put into operation, and elective cardiac arrest was performed with 5-25 cc. of 2.5% potassium citrate solution in heparinized blood. Posterolateral aspect of the base of the aorta corresponding to the site of the noncoronary aortic cusp was incised in the long axis for about 2.5-3 cm. (Fig. 52), to the most dependent line of attachment of the cusp. The noncoronary aortic cusp was then completely excised at its line of attachment, with a triangular segment of aorta opposite to it. The aortic valve and wall were reconstructed by interrupted sutures approximating annular lines of attachment of the excised noncoronary cusp, forming a new commissure and bicuspid aortic valve.

Functional evaluation was made in terms of pre- and postoperative arterial pulse patterns, transventricular and systemic pressure determinations and retrograde aortography.

Eleven dogs survived the immediate postoperative period, and 7 were long-term survivors (4-6 months). Seven of the 9 that died in the immediate postoperative period had severe dynamic aortic insufficiency as evidenced by absence of dicrotic arterial pulse curves. (Intrinsic mortality of cardiopulmonary bypass with use of an extracorporeal pump-oxygenator is under 10% in the authors' laboratory.)

More deliberate coaptation of the newly formed commissure in the last 9 experiments was attended with consistent postoperative dicrotic pulse curves and improved survival (7 survivors of the immediate postoperative period and 2 preventable deaths). High incidences of operative, gross,

(7) Surg., Gynec. & Obst. 106 679-686, June, 1958.

coronary embolism (50%) and ventricular fibrillation (95%) apparently did not deter successful results Defibrillation was accomplished electrically No significant aortic stenosis or insufficiency was produced in surviving animals

This method is directed to an alteration of the pathologic anatomy, viz, to reduce permanently the circumference of

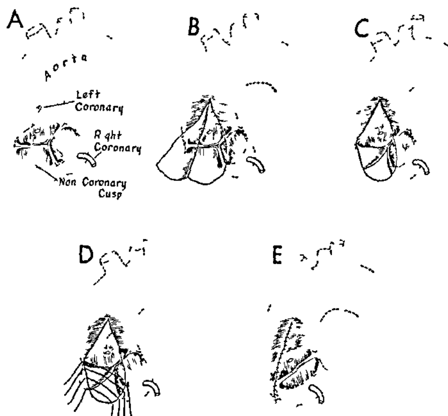


Fig 52—Conversion of tricuspid aortic valve to bicuspid valve Sequences in operative technic of aortic valve revision *A* tricuspid aortic valve *B* wedge excision of aorta *C* noncoronary cusp removed *D* suture repair and *E* bicuspid aortic valve (Courtesy of Garamella J J *et al* Surg Gynec & Obst 106 679 686 June, 1958)

the dilated aortic valve ring by a third, thus permitting coaptation and improved function of the two remaining coronary cusps Normal relation between the reconstructed aortic valve and coronary arteries is retained, no foreign body is introduced and no free homologous or autogenous graft is needed The method may be feasible and practical in diseased valves with varying degrees of loss of valve substance Isolated disease of the noncoronary cusp, as after trauma or congenital perforation, apparently is suited for this type of repair

Safe Method for Atrial Entrance in Treatment of Mitral Stenosis was devised by Jerome Harold Kay and Robert M Anderson[8] (Univ of Southern California)

TECHNIC—Three interrupted mattress sutures of no 2 silk are placed in the atrial wall or atrial appendage Tangential stitches of no 2 silk are placed at each corner A small incision is then made with a knife (Fig 53) This is the only time difficulty may arise, so care must be taken not to cut the sutures posteriorly After

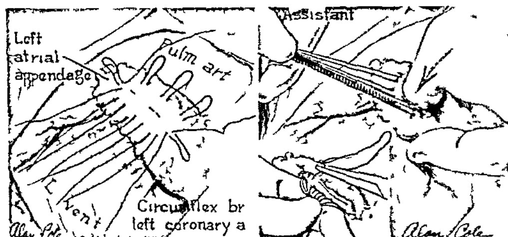


Fig 53 (left)—Placement of series of interrupted mattress sutures in atrial appendage and wall and line of incision

Fig 54 (right)—Insertion of index finger *Inset* sutures pulled taut and incision in atrial wall being closed with continuous suture

(Courtesy of Kay J H and Anderson R M Surg Gynec & Obst 108 373 374 March 1959)

the initial incision is made, it is enlarged with scissors until it will admit the index finger After the finger is inserted the sutures are pulled tight, thus obtaining complete hemostasis (Fig 54) After the commissurotomy is completed, the finger is removed and the sutures are pulled taut by the assistant The sutures may be tied or removed after the incision has been closed with a continuous stitch of 00 silk

This method is of particular value when there is no appendage, due to previous operation, or when there is a congenitally small appendage If the appendage is full of clot, an area on the atrial wall may be chosen for safe insertion of a finger or a knife, if necessary It is believed this method is superior to that of placing a purse string suture around the base of the appendage, for several reasons (1) If the purse string suture is not tied snugly, a thrombus may form in the appendage postoperatively, with danger of peripheral embolization (2) If the appendage is full of clots, it is safer to enter the atrial wall than to attempt to enter the appendage, with the danger of producing embolization (3) There is no

(8) Surg Gynec & Obst 108 373 374 March 1959

danger with this method of tearing the atrial appendage if the appendage is small

Direct Vision Correction of Mitral Insufficiency was carried out by Earle B Kay, Cid Nogueira and H A Zimmerman[9] (St Vincent Charity Hosp, Cleveland)

TECHNIC—A right anterolateral incision through the 4th intercostal space is made with transection of the sternum, if necessary The patient is positioned with about 20 degrees of elevation of the right side Manometric pressure recordings in the base of the aorta left ventricle and left auricle are taken, evaluated and correlated with preoperative cardiac evaluation studies before the cannulations are made The mitral valve is examined digitally before opening the auricle to assess the various contributing factors In patients with mixed type mitral insufficiency, as much of the commissurotomy and valve leaflet mobilization as possible is performed by closed digital manipulation before the auricle is widely opened Total cardiopulmonary bypass by means of the pump oxygenator is then begun to allow further correction under direct vision After maximal valve orifice and valve mobility are obtained by commissurotomy, site and degree of regurgitation are again appraised If regurgitation is primarily at the posteromedial commissure, the valve cusps are approximated by plicating the annulus with linear sutures placed in the anterior and posterior limbs of the mitral annulus above and below the posteromedial commissure

In some instances, particularly with the patulous type, when there is general regurgitation of blood throughout the orifice, both commissures are first widely opened, after which the annulus must be plicated at both commissures to accomplish cusp coaptation Blood is allowed to accumulate in the auricle before closing

In patients in whom elective cardiac arrest was used, transventricular or transaortic aspiration of the base of the aorta and ventricular outflow tract for entrapped air was performed while releasing the aortic clamp Temporary carotid occlusion by the anesthetist perhaps also aided in avoiding cerebral air embolism Four of the 8 hearts in which elective cardiac arrest was used had ventricular fibrillation treated by electric shock The cardiac arrest lasted 15-35 minutes The other patients had spontaneous resumption of normal heartbeat No arrhythmias occurred in the 9 patients in whom intermittent aortic occlusion was used even though the occlusion lasted 4-5 minutes in some instances A rotating disk type oxygenator was used in all patients, with flow rates of 60 80 cc/kg/minute Among 17 patients, 1 operative death occurred

(9) Surgery 44 325 332 August 1958

The authors believe that the right-sided approach to the mitral valve, allowing the heart to beat during the surgical correction, but with intermittent aortic occlusion, will be associated with the best results

Open Heart Surgery for Mitral Insufficiency. Donald B Effler, Laurence K Groves, William V Martinez and Willem J Kolff[1] (Cleveland Clinic) describe the technic which was used on 14 patients There were 4 postoperative deaths, and the surgical benefit in those who survived was ascertained by clinical means only Limited experience and short follow-up have not permitted proper evaluation, but the 10 survivors showed increased tolerance to exercise and reduction in heart size

The authors prefer a right-sided approach which permits unilateral thoracotomy when retrograde femoral cannulation is used for arterial return from the pump-oxygenator Entry into the left atrium can be accomplished through the fossa ovalis via the right atrium or through the posterior interatrial groove The transright-atrial approach offers more direct visualization of the medial commissure, reduces the hazard of postoperative bleeding, permits easier placement of sutures and allows better control of blood return to the coronary sinus The approach via the interatrial groove eliminates entry into the right heart and its attendant problems

To evaluate the diseased heart and its dynamic function properly, these must be visualized while the heart is beating Therefore, cardiac arrest is not used unless it is absolutely necessary

A more recent adjunct to open heart surgery is left heart decompression This is done by placing an indwelling catheter in the left atrium It is inserted from the right side through a stab wound where the right superior pulmonary vein enters the left atrium This permits a constant pressure reading of the left atrial chamber and allows prompt venting of blood, should there be a dangerous rise in left heart pressure

TECHNIC—The patient is placed supine, with the right chest slightly elevated Incision is made through the 4th interspace, the sternum is transected, and both internal mammary bundles are divided and ligated The left pleural space is not entered deliberately The pericardium is entered, and pressures in the chambers and great

(1) J Thoracic Surg 36 665 676 November, 1958

distribution of circumflex and septal arteries was shown as well as that of the anterior descending coronary artery Sometimes vessel outlines, either at the apex or base of the heart, were not entirely sharp, but often the entire distribu

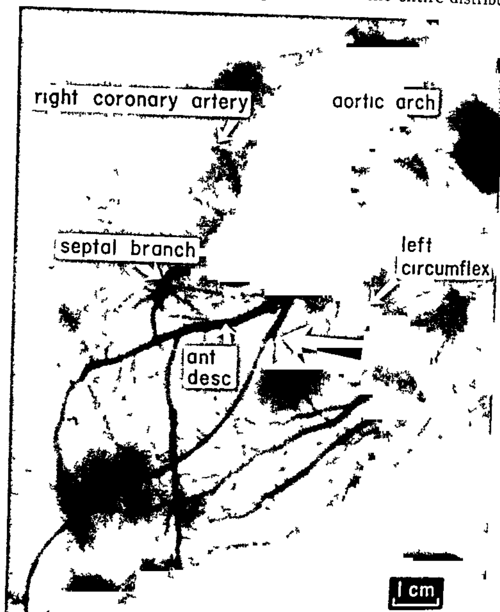


Fig 56 —Coronary arteriogram slightly enlarged in normal dog taken by technic for single angiograms Resolution is considerably greater than in serial angiograms Heart in lateral view has left aspect toward film Arrow indicates insertion site of polyethylene tube at a joint of subdivision of a coronary branch Contrast filling of left coronary system is even Arborizations of 3d order to ventricular myocardium and some atrial vessels can be seen Right coronary artery and several of its arborizations are visible with low somewhat uneven contrast Cardiac veins are not outlined Aortic bulb is well filled with contrast material all three sinuses of Valsalva are well outlined Contrast is irregular in arch of aorta and its branches (Courtesy of Bellman S and Frank H A J Thoracic Surg 36 33 43 July 1958)

tion of the left coronary artery was sharply visualized so that branches of the 3d order could be made out (Fig 56) The pattern was reproduced well in repeated angiograms, with variation only in extent of outlining of branches of the 3d order The cannulated branch beyond the point of ligation was not visualized in the initial angiograms The right coronary artery was delineated to some extent in most arteriograms but usually in discontinuous segments, according to entry of contrast medium from the root of the aorta Even when arborization of the right coronary artery was shown quite extensively, photographic contrast was low Main cardiac veins and their 1st and 2d order tributaries could be distinguished, but photographic contrast was never as high as in arterial images

The method in general seems suitable for its intended purpose of delineating coronary arteries in experimental proce dures requiring a direct approach to the heart It may be possible to use single angiograms of this kind clinically, in direct surgical procedures on coronary arteries, particularly if the branch used for injection can be saved by immediate removal of the cannula or needle or by incorporation of that branch in the vascular reconstruction

Arteriographic Studies of Coronary Arteries in Ischemic Heart Disease were carried out by Alan P Thal, L Stephen Richards, Richard Greenspan and M John Murray[3] (Univ of Minnesota)

METHOD —The injection apparatus consists of a compressed nitro gen driven syringe fired by a solenoid valve It can deliver 65 cc of 90% diatrizoate (Hypaque®) sodium) through a size 330 polyethylene catheter in 1 second Best delineation of the coronary vessels is obtained by rapid injection of concentrated dye timed to start at the beginning of systole and continue for 1 cardiac cycle At heart rates of 60 80 beats/minute, the injection is carried out over 0 8 0 6 second To obtain precisely timed injections, a variable delay circuit is used The circuit is triggered by the R wave of the ECG, and duration of injection is varied according to the heart rate Access to the ascend ing aorta is through the brachial artery The artery is exposed in the upper part of the arm and a transverse arteriotomy is made The Schonander biplane units which allows 6 films/second in two planes, is satisfactory for detailed studies of the coronary circulation

A normal coronary system is shown in Figure 57 and extreme atherosclerosis in Figure 58

(3) J A M A 168 2104 2109 Dec 20 1958

Diagnosis of myocardial ischemia can often be made with great accuracy on the basis of the history and ECG findings, yet there is a small but definite group of patients in whom diagnosis remains in doubt despite careful clinical study

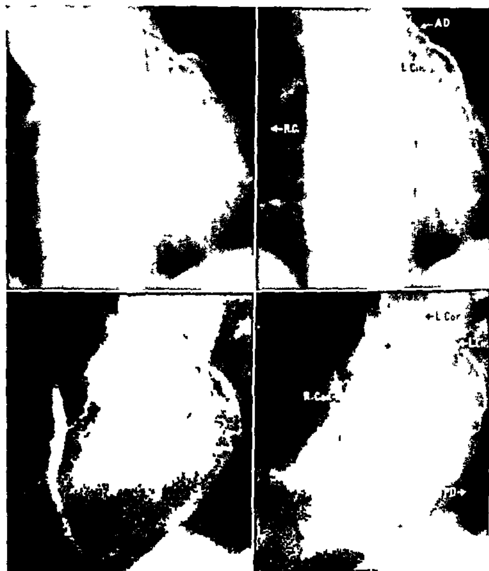


Fig 57 —Anteroposterior and lateral views of coronary arteriogram in patient with angina like symptoms Arteriogram shows entirely normal pattern *L Cor* left coronary artery *R Cor* right coronary *L Cir* left circumflex branch *AD* anterior descending branch *PD* posterior descending coronary artery (Courtesy of *Thal* A P *et al* J A M A 168 2104 2109 Dec 20 1958)

These problem cases may readily be resolved by coronary arteriography, which may now be done with small risk and little discomfort to the patient

It is now apparent from the results of various surgical

procedures for myocardial revascularization that there is a strong functional element in many patients with angina pectoris The extent of this functional overlay can be judged from the patient with established angina pectoris who obtains relief from symptoms after nothing but a skin incision



Fig 58 —Sections of coronary arteries superimposed on arteriogram of patient with severe angina at rest Extreme narrowing extending far out into periphery (Courtesy of Thal A P *et al* J A M A 168 2104 2109 Dec 20 1958)

Apart from the diagnostic value of these arteriographic studies, it may be possible with increased experience to formulate a more accurate prognosis in coronary sclerosis, based on such factors as the extent of the disease and the collateral response Last, but perhaps most important, the method offers a basic research technic for evaluation of the early vascular reactions to ischemic myocardial insult

► [Satisfactory coronary arteriography is undoubtedly a useful adjunct in assessment of the degree of coronary insufficiency and is vital to determining the ultimate position of surgery in this disease Coronary endarterectomy should not be attempted in a patient without arteriograms —Ed]

Improved Method of Coronary Arteriography was developed by Louis H Frische and Charles T Dotter[4] (Univ of Oregon)

TECHNIC —The procedure is carried out under general anesthesia Continuous ECG recording is provided for Before exposing the right radial artery, a type I Dotter Lukas double lumen balloon catheter (Fig 59) is prepared by rinsing in heparin solution The injection lumen is then filled with heparinized saline and connected to a syringe containing the same mixture After the radial artery has been exposed the catheter is introduced through a small trans

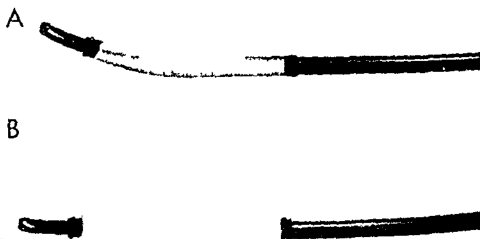


Fig 59 —Type I Dotter Lukas double lumen balloon catheter *A* distal end of catheter with undistended balloon *B* same catheter after inflation of balloon with 15 cc nitrous oxide (Courtesy of Frische L H and Dotter C T Dis Chest 35 546 553 May 1959)

verse incision and passed proximally under fluoroscopic control until the tip lies in the ascending aorta about 1 in above the aortic valve This part of the procedure is greatly facilitated by a Philips Surgery image intensifying fluoroscope

After the catheter has been properly positioned trial inflation of the balloon is accomplished using either nitrous oxide or carbon dioxide (up to 50 cc for the larger balloon required for human use) Air should not be used for this purpose because of potential embolism if the balloon were to burst Total aortic occlusion is the objective and is indicated by complete bilateral disappearance of the carotid pulse

After the quantity of gas required for total aortic occlusion has been ascertained coronary arteriography may be started The balloon is rapidly inflated then the contrast medium is injected as fast as pos

(4) Dis Chest 35 546 553 May 1959

sible through the second lumen of the catheter The contrast agent can be injected by hand for coronary arteriography in the dog because only 3 6 cc is required The larger doses necessary for visualization in the human subject (10 20 cc) require pressure injection apparatus Serial radiography is initiated at the beginning of injection and continued at a rate of 1-2 films/second for about 6 seconds The occluding balloon is deflated after injection of contrast medium, even before the radiographic series is completed Deflation of the balloon



Fig 60 —Coronary arteriography with 4 cc Thorotrast Slight aortic insufficiency (*arrow*) does not interfere with good visualization of coronary arteries (Courtesy of Frische L H and Dotter C T Dis Chest 35 546 553 May, 1959)

should be prompt, but the piston of the syringe must not be forcibly retracted, else a portion of the balloon might be aspirated into the lumen of the catheter After the radiographic sequence is completed and the balloon has been deflated, the catheter may be removed and the artery repaired

Considerable experience in the experimental laboratory has shown that this technic produces excellent coronary visualization in virtually every instance (Fig 60)

Experimental Evaluation of Internal Mammary Artery Ligation as Method of Myocardial Revascularization John

H Vansant and William H Muller, Jr[5] (Univ of Virginia) used three experimental approaches in dogs to determine whether internal mammary artery ligation increases collateral blood flow to the heart The mortality rate after ligation of a major coronary artery was used to judge the degree of protection afforded the heart Mortality rate was 90% among 10 controls After ligation of the internal mammary arteries, the mortality rate was 70% of 20 dogs These results are not indicative of statistically significant myocardial protection

A technic was devised to measure pressures simultaneously in the internal mammary artery, and pressures and flows in a tributary of this vessel that is comparable to the pericardiophrenic artery Occlusion of the internal mammary artery distal to the tributary did not significantly affect the pressures in the internal mammary artery or in the tributary, neither did it appreciably increase the volume flow through the tributary

The third method of evaluation consisted of measuring the acute effects of bilateral internal mammary artery *ligation* on the retrograde pressures and flows of an occluded coronary artery No significant change in either measurement occurred when the internal mammary arteries were totally obstructed

No evidence was obtained from these studies to demonstrate that bilateral internal mammary artery ligation increases, to any extent the collateral blood supply to the myocardium

***Experimental Ligation of Internal Mammary* Artery and Its Effect on Coronary Occlusion** Despite reports from Italy and from some surgeons in this country of successful clinical results of ligation of the internal mammary artery in treatment of coronary arterial insufficiency, skepticism remains regarding the value of this procedure David C Sabiston, Jr, and Alfred Blalock[6] (Johns Hopkins Univ) performed experiments on 47 dogs to evaluate protection of the heart offered by this procedure

The volume of blood flow in the internal mammary artery was determined after experimental ligation of this vessel in

(5) Surgery 45 840 847 May 1959
(6) Ibid 43 906 912 June 1958

the 2d intercostal space Flow was measured immediately after ligation in some dogs and after several weeks in others *Volume of flow was fairly small in both groups,* with correspondingly low values for backpressure and backflow Small arterial communications between the internal mammary branches and perivascular arteries along the great vessels entering the heart could be demonstrated by injection technics, although no protection of the heart against deliberate ligature of the anterior descending coronary artery was found

Blood flow in the internal mammary artery was significantly increased in the chronic preparation, in experiments in which concomitant ligation of the rest of the subclavian branches was performed Despite increases in flow, backpressure and backflow consistently observed under these circumstances no protection appeared to be offered the heart when the anterior descending coronary artery was ligated

► [Sufficient evidence has now accumulated to indicate that any beneficial results from internal mammary artery ligation are largely psychogenic Let us hope that this procedure will now be relegated to surgical desuetude. —Ed]

Experimental Basis for New Operation for Coronary **Artery Disease Left Atrial Pulmonary Artery Shunt to Encourage Development of Interarterial Intercoronary Anastomoses** Stacey B Day and C Walton Lillehei[7] (Minneapolis) demonstrated in dogs that intercoronary interarterial anastomoses may be produced after surgical production of an arteriovenous fistula between the main pulmonary artery distal to the semilunar valves and the left atrium In all the test animals, richly abundant intercoronary channels were present between *major and minor rami of the left coronary* artery Only 30% of the controls demonstrated comparable collateral vessels between rami of the left coronary arteries Results were challenged by acute ligation of the circumflex coronary artery

Injection corrosion casts of the distribution of the coronary arteries in the operated dogs provided an objective explanation for their survival after acute ligation In all demonstrations (including 1 dog that showed fibrillation within 3 minutes) increased intercoronary channels were evident In most preparations the circumflex coronary artery or its

(7) Surgery 45 487-495 March 1959

branches distal to the point of acute ligation was filled by retrograde flow of the injection mass from the left anterior descending artery

Postmortem examination of the hearts before injection of the coronary arteries revealed that in 3 dogs organized thrombus had occluded the shunt Sufficient intercoronary channels had apparently been provoked, however, to enable the hearts to withstand the acute ligation In 4 test animals normal cardiac rhythm was interrupted by ectopic beats within 5 10 minutes of ligation This change spontaneously regressed in all and strong regular rhythm was restored in a further 10 15 minutes

The authors report a case in a man, 47, with widespread extensive coronary arteriosclerosis, as noted by coronary arteriography, who had pulmonary artery left atrial anastomosis At operation, the main pulmonary artery was joined to the left atrial appendage by side to side anastomosis 2 cm long Clinical response to this procedure was dramatic and sustained

► [The authors present a unique approach to the problem of coronary insufficiency but the practical application of this concept of therapy will require careful study and evaluation Patients of advanced years with emphysema and cor pulmonale may not tolerate this procedure —Ed]

Applicability of Angioplastic Procedures in Coronary Atherosclerosis Estimate through Postmortem Injection Studies was made in 190 hearts by D Emerick Szilagyi Richard T McDonald and Lloyd C France[8] (Henry Ford Hosp) Distribution and state of advancement of atherosclerotic lesions were studied after injection with a barium glycerine mixture at autopsy No occlusive change of importance was noted in 76 specimens, all from cases without clinical arteriosclerotic heart disease Among the 114 hearts with occlusive lesions, 35 came from patients with no clinical manifestation of coronary atherosclerosis and 79 from patients with clinical atherosclerotic heart disease 23 of these had had angina pectoris as the sole or main clinical sign

The earliest and most sharply localized occlusive lesions were found in the subclinical group, the most advanced and widespread involvement occurred in the clinical group with angina For the most part, it appeared that coronary athero

(8) Ann Surg 148 447-461 September 1958

sclerosis when clinically manifest tends to be generalized Judged by technical criteria which include consideration of topographic accessibility, luminal size and outflow characteristics of main coronary branches, 43% of the hearts in the subclinical groups were judged inoperable, 17% as capable of palliation and 40% as capable of cure by direct surgical means In the clinical group with angina, the theoretical

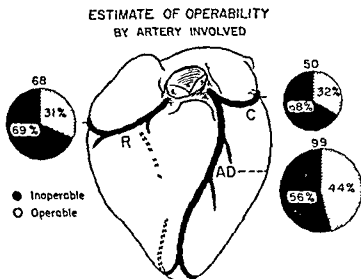


Fig 61 Relative incidence of operable and inoperable occlusive lesions in main coronary arterial branches (Courtesy of Szilagyi D E et al Ann Surg 148 447 461 September 1958)

rate of inoperability was 44%, possibility of palliation 43% and rate of curability 13%

In cases with hearts free from occlusive disease, sex distribution was the expected normal—almost even, with slight female predominance, among patients with occlusive disease, incidence of males was much higher (77%) Incidence of previous myocardial infarction in the two clinical groups was significantly different—43% in the group without angina and 87% in the group with angina In the former group, 34% died of terminal myocardial infarction, in the latter, 74% Fifty five per cent of the lesions located in the anterior descending coronary, 69 2% of those in the right main coronary and 68 8% of those in the circumflex coronary artery were inoperable (Fig 61)

From the viewpoint of atherosclerotic involvement, the coronary arterial system differs from the peripheral arterial tree in two respects that militate against effective direct sur-

gical methods In peripheral arteries, skip areas between obliterating lesions are far enough separated to permit surgical maneuvering Because of short distances in the coronary arterial trunks, atheromatous segments are close together, tend to coalesce and often render surgical interference difficult or impossible Moreover, coronary collateral arteries are minute vessels intercommunicating with each other rather than shunting blood around the point of occlusion in major branches The generally small size of coronary vessels compounds the difficulty Also, in general before being clinically manifest, coronary atherosclerosis must become quite diffuse, and localized segmental lesions amenable to cure by direct surgical attack are usually asymptomatic

The role that direct surgical procedures may assume in treatment of coronary atherosclerosis appears to be restricted The potential usefulness of grafting seems to be slight, certainly much smaller than that of endarterectomy As to possibility of cure, the outlook is quite unpromising If the aim is narrowed to some degree of palliation, there may be a justifiable place for direct surgical intervention in some cautiously selected cases Without angiographic aid the task of making this selection would seem to be hazardous and difficult, but not impossible

Evaluation of Implantation of Internal Mammary Artery into Myocardium of Pigs and Dogs was made by Howard H Patt, Mauricio Golberg, John V Clift and Bunket Lourvanij[9] (Baltimore) A significant anastomosis was demonstrable in only 1 of 19 dogs (5 3%) and in only 1 of 25 pigs (4%) subjected to implantation of the internal mammary artery after partial ligation of the left anterior descending artery

It is difficult to evaluate objectively the efficacy of a revascularization procedure on the human myocardium Obvious clinical improvement may follow an operative procedure but it may be entirely unrelated to the specific operation used Precise evaluation of an advocated operative procedure, by suitable laboratory study is of primary importance

In the authors' hands, implantation of the internal mammary artery into the myocardium was not a satisfactory

(9) J Thorac c Surg 35 699 705 June 1958

method for improving blood supply to the heart An occasional successful result was obtained but not often enough to warrant use of this procedure in patients Intimal proliferation was consistently present and could be found to some degree even in the successful implant This may eventually be circumvented by use of a larger vessel or by an artificial graft

In performing a flow study on an implanted vessel, it is essential to ascertain exactly where the perfusate is going An anastomosis via adhesions to the sternum or mediastinal fat may result in a misleading flow study Small leaks from such vessels which have been divided are readily detected when the perfusate is colored with methylene blue Failure of the dye to discolor the myocardium is further evidence that flow through the implant is not synonymous with flow into the heart muscle

Injection of Schlesinger's mass into the implant is important in establishing the caliber of the anastomotic channels The mass will not traverse a vessel with a diameter less than 40 μ This material was successfully injected into only 1 dog

Coronary Heart Disease after 25 Years According to Claude S Beck[1] (Western Reserve Univ), three death factors occur in coronary heart disease (Fig 62) Requirements for treatment of each factor can be determined Most deaths are due to self electrocution of the heart This factor kills under a variety of conditions In many instances the heart is too good to die Sometimes this factor is reversible and life can be restored Its incidence is reduced by presence of intercoronary communications It is probably the only factor for which effective surgical treatment exists

The second death factor is inadequate inflow to support the heartbeat The muscle may or may not be severely damaged No effective operation is known for this condition Clinical recognition is not always possible Loss of strength and inability to get around may indicate severe inflow reduction The third death factor is loss of muscle As there is not enough muscle to propel the blood, failure develops The heart is enlarged The only treatment is that for failure, no operation exists

The author s operation, or some modification of it, was

(1) J Thoracic Surg 36 329 351 September, 1958

performed on 347 patients Total mortality during hospitalization was 6% and after discharge during somewhat over 4 years, 9 2% Operative mortality among 200 consecutive patients was 2% Of the 347 patients, 110 (32%) were classified as salvage, 234 (67%) as nonsalvage and 3 were not classified According to this classification, a third of the patients operated on were approaching the terminal stages of

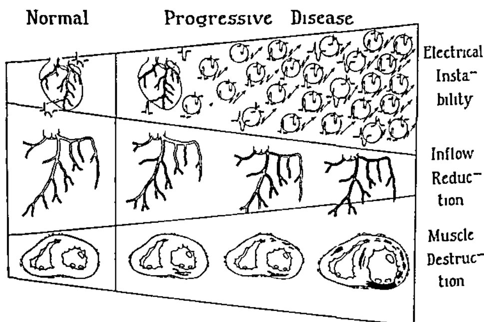


Fig 62—Three death factors in coronary heart disease (1) self electrocution of heart (2) terminal stage in reduction of arterial inflow and (3) terminal stage in destruction of muscle (Courtesy of Beck, C S J Thoracic Surg 36 329 351 September, 1958)

the disease, when mortality could be expected to occur in the not too distant future Total mortality during the 4 years was 26% among the 110 salvage patients and 10% among the 234 nonsalvage patients In nonsalvage patients, risk of operation is low and life span probably excellent

Of the 347 patients, 295 were still living Among 278 living patients, clinical results were excellent in 32% and good in 62% Among living salvage patients, results were almost as good as in the entire group

THE AORTA AND PERIPHERAL ARTERIES

Importance of Early Exploration of Vascular Injuries is stressed by William H. Sinkler and Andrew D. Spencer[2] (Homer G. Phillips Hosp., St. Louis) on the basis of a 10-year experience with 83 patients aged 21 months to 76 years (72 males). The time interval from injury to admission varied from 10 minutes to 5 days (average 1.1 hours) and from admission to exploration, 20 minutes to 13 hours (average 4.2 hours). For 26 patients admitted in shock, the interval from admission to surgery was 2.6 hours.

Arterial injuries were present in 42 of the 83. Often, the accompanying veins were also involved. Arteries most often injured were brachial, femoral and popliteal, and the most frequent injury was transection, followed by laceration and perforation. Of the 12 vessels ligated, 5 were of major importance. In 27 repair was by simple suture, or by resection of the damaged segment and reanastomosis or by insertion of a homograft or autograft. No prostheses were used in these patients. Two patients required only decompression and local application of vasolytic agents. No definitive treatment was carried out in 2 because 1 died on the table and the other showed innumerable minute perforations of a long segment of the superficial femoral artery from a shotgun wound. Viable extremities with pulsations were obtained in 21 (72.7%) of the 27 arteries repaired. If 2 deaths not due to any treatment to the arteries are excluded, the percentage is 84.

In 16 patients, injury to a major vein or one of its larger branches was present. The vessel most often injured was the internal jugular vein, followed by the superficial femoral. Nine venous injuries were lacerations, 5 were transections and 2 were perforations. Ligation was done in 12 and suture repair in 3. The veins sutured were a superficial femoral, a subclavian and an innominate. In 2 patients wound infections developed. In 1, transient edema of the lower extremity occurred after ligation of the superficial femoral vein. No

(2) Surg., Gynec. & Obst. 107 228 234, August, 1958.

major complications were attributable to actual ligation of the injured veins One death resulted from massive hemorrhage from the external iliac vein before the injured vessel could be exposed and controlled The authors believe that ligation of major veins serves no good purpose, and since 1956 the policy has been to repair all major veins

Exploration was performed in any patient with a penetrating wound and one or more of the following criteria pulsatile or active bleeding, distal arterial insufficiency, pulsating or increasingly large hematoma or penetrating wound over the course of any large vascular bundle Locations demanding exploration are the neck, axilla brachium antecubital space and femoroinguinal and popliteal areas Among 42 arterial injuries, major indication for exploration in 20 (47 6%) was distal arterial insufficiency, in 10 active bleeding and in 2 pulsatile bleeding In 5, location of the wound was the indication Among 16 major venous injuries, active bleeding was the indication in 14 (87 5%) and location of the wound in 2 Of 25 explorations in which no major artery or vein was injured, 12 were performed because of hematoma or active hemorrhage and 13 because of location of the wound Effective control of bleeding vessels in 12 prevented or decreased hematoma formation, in 2 bleeding of minor vessels was sufficient to have caused shock Major arterial or venous injury was present in 25 of 27 patients admitted in shock, 20 had arterial injuries

All penetrating wounds in the vicinity of great vessels should be explored immediately, or arteriograms should be made to exclude arterial injury Arteriograms do not exclude the presence of major venous injury Ligation of major vessels is undesirable Immediate restoration of injured arteries, by resection of damaged areas and primary repair with simple suture or with autografts or homografts achieves the best results Infection should be avoided by aseptic technic and use of antibiotics

Management of Lacerations of Great Vessels of Upper Thorax and Base of Neck The wounds are often quickly fatal, owing to exsanguination The sustained high pressure thin elastic wall and absence of stout tissues to abut a clot firmly and continuously against the injured area militate against quick formation and maintenance of clotted sealing

of a lacerated artery before blood loss is fatal. Persons who survive the initial episode show massive hematomas, which may become infected and are prone to early or late secondary hemorrhage. Great-vessel injuries do not heal cleanly as a rule, and the few patients who ultimately survive usually show an aneurysm or arteriovenous fistula.

Patients who reach the hospital alive should be regarded as salvageable by an aggressive program involving immediate thoracotomy, with control of hemorrhage, rapid replacement of blood volume, cardiac resuscitative measures as indicated and definitive repair of injured structures. Frank Buckner, Champ Lyons and Rex Perkins[3] (Med. College of Alabama) report on 8 patients in whom such a program was followed, with no deaths.

All patients had external wound sites, suggesting the possibility of major vessel injury, moderate distress and cardiovascular collapse, attenuated in most cases by drunkenness. Three were actively bleeding, and 3 required continuous digital pressure to control active hemorrhage. Three showed associated lesser injuries. Average time from injury to arrival at the emergency room was about 30 minutes. Some patients immediately received fluids or blood intravenously; others were taken straightway to surgery. Systolic pressures on admission were 70-120. Three patients showed a hematoma in the wound area, 5 had hemopneumothorax and 2 had a widened mediastinal shadow by x-ray. During surgery 2,000-9,000 cc. whole blood was used. Actual repair of injured vessels was not difficult once adequate exposure and proximal control were secured. The stable physiologic status on the operating table after control of hemorrhage and restoration of blood volume was striking. Postoperative course was generally smooth.

Although anterolateral thoracotomy, a cervical incision or both may be used, the authors rely most heavily on the vertical sternum-splitting approach to provide adequate exposure for repair of lacerated vessels. The superior vena cava, innominate veins, pulmonary artery, ascending aorta, aortic arch and innominate, common carotid and subclavian arteries can be visualized and hemorrhage controlled. The incision can be extended as the situation requires (Fig. 63).

(3) Surg., Gynec. & Obst. 107:135-142, August, 1958.

Postoperative discomfort is minimal if bony parts are approximated accurately and held securely by wire. If there is injury of a great vessel at the thoracic inlet or lower neck, the incision may be extended into the neck along the anterior border of either sternocleidomastoid muscle, thereby exposing the carotid and subclavian arteries and the jugular

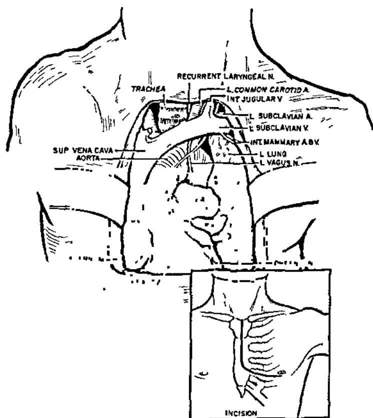


Fig. 63.—Vertical sternum splitting incision with extension into left 4th intercostal space (Courtesy of Buckner, F., *et al* Surg., Gynec. & Obst 107:135 142, August, 1958.)

and subclavian veins (Fig. 64) Once the vessel is exposed, hemorrhage may be controlled by finger pressure and proximal and distal control then secured. Careful primary suture of the injury with maintenance of vessel patency is the desired goal. Simple over-and-over everting continuous fine silk repair is satisfactory. If primary repair is impossible, grafting or ligation may be performed. Either innominate, subclavian or internal jugular veins can usually be safely occluded. Ligation of both innominate veins should be avoided, as should occlusion of the superior vena cava, because of resultant morbidity from venous suffusion. The

nearer to the heart any major artery is ligated, the better the collateral circulation and the safer the procedure. The intrathoracic portion of either subclavian artery may usually be ligated safely. Ligation of the innominate artery does not produce gangrene of the upper extremity, but there is a re-

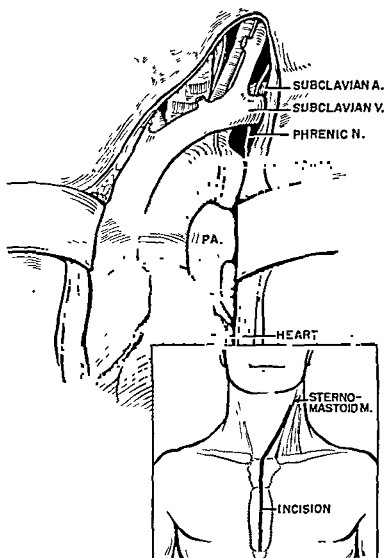


Fig 64 —Vertical sternum splitting incision with extension along anterior border of sternocleidomastoid muscle (Courtesy of Buckner, F, *et al*: Surg, Gynec & Obst. 107.135 142, August, 1958)

ported 9% mortality from cerebral complications. Ligation of the cervical portion of the subclavian and axillary artery is accompanied by low incidence of gangrene and is preferably avoided. Ligation of the common carotid artery is hazardous, with reported mortality of 20-30%, and high inci-

dence of cerebral complications, particularly in old patients

Surgery of Traumatic Arteriovenous Fistulas and Aneurysms: Five-Year Follow-up Study of 215 Lesions is reported by Carl W. Hughes and Edward J Jahnke, Jr[4] (Walter Reed Army Med Center). Vessels of the head and neck were involved in 11 1%, of the upper extremity in 32 6% and of the lower extremity in 56 3% Major vessels were involved in 134 lesions

Initially, the lesions were managed by obliteration Arteriovenous fistulas were treated by quadruple ligation and excision and aneurysms by endoaneurysmorrhaphy or ligation and excision Operation was delayed about 3 months or over for development of adequate collateral circulation To eliminate the long preparatory period, need of sympathectomy and occurrence of arterial insufficiency, restoration of major vessel continuity was initiated The preferred procedure was direct anastomosis, but lateral repair, division of the fistulous tract and grafting procedures occasionally were indicated Simultaneous venous repair was used in about 30% of major veins involved in fistula formation Eight patients required no operation because spontaneous closure of the fistulas and aneurysms occurred during hospitalization, 6 of these lesions involved major vessels In all patients, heart size returned to normal soon after elimination of the fistula Only 2 showed evidence of cardiac failure, and both responded to excision of the fistula and repair of artery and vein

Follow up examination was possible in 76 of the 134 patients Two patients died after operation, 1 of endocarditis during hospitalization and 1 of tuberculosis 3½ years after return to military duty At follow-up, 15 patients had burning pain at rest, 7 had been treated by ligation of major vessels and 8 by reparative surgery Six of the extremities involved were upper and 9 were lower Coldness in the extremity was present in 25 patients, 14 had reparative procedures Some claudication was present in 24, of whom 14 had reparative operations Five of 22 had no palpable pulse in the injured extremity, 4 had weaker pulses, 11 had equal pulses and 2 had stronger pulses than in the uninjured extremity Seventeen patients in the follow-up series had sym

(4) Ann Surg 148 790 797, November, 1958

pathectomy, 7 before and 10 after operation Swelling persisted in the involved extremities in 6 patients, and in each of these the vein was ligated Varicosities were present in 20 (15 lower) extremities Arteriovenous fistulas had been present in 17 The veins were ligated in 18

Among 15 patients who changed occupation because of the injury, the lower extremity was involved in 12 and the upper in 3 Reparative vascular surgery had been performed in only 4, whereas 11 had had the vessels ligated Nerve injury and venostasis were among the causes leading to change in occupation

Subjective evaluation of results was poor in 11 (10 had ligation), satisfactory in 17 and good to excellent in 43

Obliterative technics are acceptable for most minor vessel lesions, but 50% of patients with obliterative procedures for lesions of major vessels, predominantly in the lower extremities, had poor results These data indicate the desirability of reparative vascular surgery, especially in the lower extremities

Surgical Considerations of Peripheral Arterial Aneurysms. Analysis of 107 Cases is presented by E Stanley Crawford, Michael E De Bakey and Denton A Cooley[5] (Baylor Univ) Among the 107 patients, the aneurysm was arteriosclerotic in 54, of traumatic origin in 37, occurring in homografts in 7 and false aneurysm occurring after peripheral arterial operations in 6, 3 had poststenotic aneurysm of the subclavian artery

Of the 54 arteriosclerotic aneurysms, 30 were located in the popliteal artery, 23 in the femoral and 1 at the bifurcation of the innominate artery Relatively high incidence of multiple lesions was evident in that more than one arteriosclerotic aneurysm was present in 55% of the patients Traumatic aneurysm resulted from a gunshot wound in 25 patients and a stab wound in 12 In 12 patients, the lesion was a false aneurysm and in 25, there was a false aneurysm and an arteriovenous fistula These traumatic lesions were widely distributed, but in 29 (80%) patients, the aneurysm involved an artery *necessary for normal blood flow, e g*, the carotid, brachial, femoral, popliteal or subclavian In 3 patients, poststenotic aneurysm was located in the subclavian

(5) A M A Arch Surg 78 226 238 February 1959

artery just distal to a constriction produced by the anterior scalenus muscle In 3 of 7 patients with aneurysms in peripheral homografts for treatment of occlusion of the femoral artery, the lesion developed 8 26 minutes after operation Trauma was the cause of aneurysm in 1 patient, and abnor



Fig 65 (above left) —False aneurysm of right brachial artery showing specimen and its arteriographic appearance
Fig 66 (above) —Lesion at operation
Fig 67 (left) —Restoration of normal circulation by excision and end-to-end anastomosis of uninvolved arterial segments
(Courtesy of Crawford E S *et al* A M A Arch Surg 78 226 238 February 1959)

mal immunologic response was suggested, but not proved in the other patients The etiologic factor in development of false aneurysms after operation was a combination of infection, tension at the suture line and fraying associated with use of the Edwards Tapp nylon tube

Clinical manifestations of the disease varied according to the type of lesion. Patients with arteriosclerotic aneurysms were considerably older than those with the other aneurysms and often had associated heart disease and hypertension.

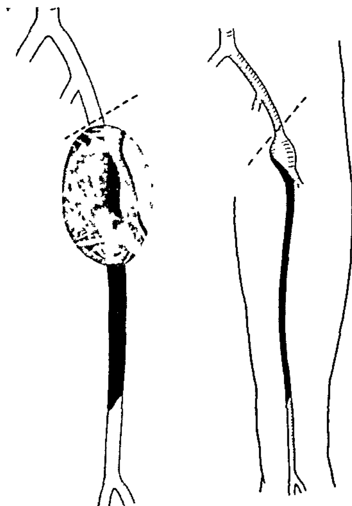


Fig 68 —Photograph taken at operation and diagrams showing aneurysm of common femoral artery associated with segmental occlusion of superficial femoral artery and patency of deep femoral artery (Courtesy of Crawford, E S, *et al* A M A Arch Surg 78 226 238, February, 1959)

sion. The presenting symptom in most of the patients, regardless of the type of lesion, was a pulsating mass. Thrombosis was present in a significant number and was associated with arterial insufficiency in all Rupture had occurred in 8 patients with arteriosclerotic aneurysms and heart failure was present in 3 with arteriovenous fistulas.

The lesion was localized to an operable segment of artery in all instances; treatment was directed at excision of the lesion and restoration of circulation. Aneurysms were ex-

cised in all the patients and restoration of circulation was possible by end to end suture (Figs 65 67) of the uninvolved segments in 45 instances—14 arteriosclerotic 29 traumatic and 2 poststenotic aneurysms of the subclavian artery The defect remaining after excision of the lesion in the other patients was of sufficient length to require an ar-

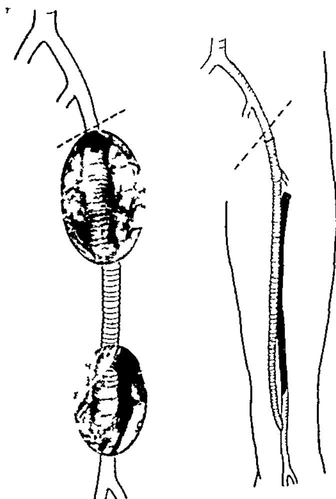


Fig 69 —Photograph taken at operation and diagrams showing Dacron tube replacing aneurysm and bypassing segmental occlusion of superficial femoral artery Restoration of circulation to thigh is evident by anastomosis between graft and deep femoral artery (Courtesy of Crawford E S *et al* A M A Arch Surg 78 ? 6-238 February 1959)

terial substitute to restore peripheral circulation Figs 68 and 69) For this purpose, homografts, Dacron tubes and the Edwards-Tapp tube were used

Results were extremely gratifying, particularly when compared with the natural course of the disease Normal circulation was restored in most of the patients Amputation

was required in only 6, though many had arterial insufficiency and gangrene at time of operation Despite the high incidence of associated heart disease and hypertension, only 3 patients died, all of whom had arteriosclerotic aneurysms 2, operated on for ruptured aneurysm, died of myocardial infarction and 1 died of air embolism

Follow-up was over 3½ years in most instances and results have been well maintained Three patients with arteriosclerotic aneurysms have died since operation, 1 of ruptured aortic aneurysm, 1 of myocardial infarction and 1 of cancer Arterial occlusion occurred in only 3 patients, amputation was not required in any patient since discharge

Nonpenetrating Traumatic Injury of Aorta Rupture or laceration of the aorta is a more common result of nonpenetrating traumatic injury than is generally appreciated Loren F Parmley, Thomas W Mattingly, William C Manion and Edward J Jahnke, Jr[6] (Washington, D C) reviewed 296 cases of nonpenetrating traumatic injury that resulted in aortic laceration in 21 and rupture in 275 The commonest site of rupture was at the aortic isthmus, just distal to the left subclavian artery Almost a fifth of all persons with traumatic aortic rupture but no associated cardiac lesions may be expected to survive at least temporarily The overall survival rate was 13 8%

Clinical manifestations of traumatic aortic rupture vary In patients in critical condition, symptoms suggesting a cardiovascular lesion may not appear until hours or days after injury, often with development of premonitory signs or symptoms of impending hemorrhage, followed by sudden death Other patients may show signs and symptoms of aortic aneurysm with impending rupture weeks or months later, or in absence of significant symptoms, aortic aneurysm formation may be revealed by routine chest x rays Rarely, aneurysm with dissection may follow traumatic aortic injury

Unexplained hemorrhage and hemothorax with x-ray evidence of widening of the mediastinum are the early manifestations of diagnostic importance After the first 24 hours, when the condition of the patient becomes stable, probabilities for diagnosis are greatly improved Signs and symp-

(6) Circulation 17 1086 1101 June 1958

toms of aortic rupture then resolve into those produced by a mediastinal mass, the hematoma or false aneurysm and the tendency of this aneurysm to leak blood This often produces a delayed or recurrent hemothorax, the one most important diagnostic feature

In 3 other patients, retrograde aortography proved to be the most effective roentgenographic means of delineating the extent of the lesions Surgical treatment of a false aneurysm that has remained stable for a prolonged period has been successful, but in some instances conservative management may be the treatment of choice The authors successfully resected a traumatic aortic aneurysm in 2 patients

► [On the basis of our experience, we would take strong exception to the advocacy of conservative management of [illegible] of the aorta As emphasized in the editorial comment [illegible] Book, these lesions may occasionally re[illegible] relatively long periods, but in most instances progression with ultimate rupture takes place On the other hand surgical treatment of these lesions has provided highly gratifying results as evidenced by our own experience in 16 cases, with success in all but 1 For these reasons, surgical treatment is strongly recommended in all such cases unless there are serious contraindications to operation such as severe cardiac, cerebral pulmonary or systemic diseases —Ed]

Aneurysms of Thoracic Aorta: Analysis of 179 Patients Treated by Resection during the past 7 years is presented by Michael E De Bakey, Denton A Cooley, E Stanley Crawford and George C Morris, Jr[7] (Baylor Univ) Cases were classified into four groups

Group 1, aneurysms of the descending thoracic aorta 73 cases, reflects the relative frequency of this involvement In excisional therapy, the most important consideration arises from the necessity for temporary arrest of aortic circulation *through the segment to be resected and the consequent ef*fect of increased vascular resistance on the heart and ischemic damage to the spinal cord

Hypothermia was for some time the primary means for prevention of neurologic sequelae Because of certain disadvantages, a method of controlled extracorporeal circulation was developed, consisting of a pump-bypass in which oxygenated blood is removed from the left auricle and pumped into the aorta distal to the occluding clamps through a plastic cannula inserted upward into the left femoral artery This method was applied in the last 36 patients, and mortality

(7) J Thoracic Surg 36 393 420 September 1958

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was reduced from 27% (in the first 37) to 19% That 2 patients in each series showed some neurologic disturbance unexplainable by any variable in method or condition of the patient suggests that considerable variations exist in tolerance of the spinal cord to temporary aortic occlusion Age, etiology, hypertension and pre-existing heart disease are

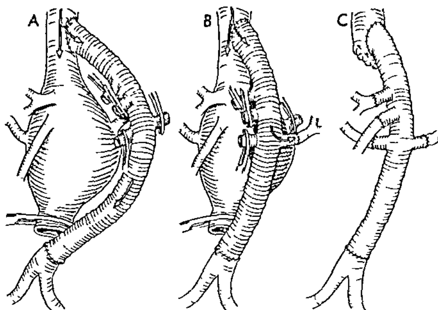


Fig 70 —Method of resection and graft replacement in thoracoabdominal aneurysms *A* Dacron tube is attached to descending thoracic aorta above aneurysm by end to side *anastomosis and to abdominal aorta below aneurysm by end to-end anastomosis* *B* left renal artery is attached to corresponding branch on Dacron tube by end to-end anastomosis and blood flow restored to left kidney occluding clamps are then applied to remaining visceral branches and to aorta above aneurysm but below proximal end to side anastomosis of Dacron tube and aneurysm is excised *C* end to end anastomosis is then done between respective branches of Dacron tube and right renal superior *mesenteric and celiac arteries in that order* with restoration of circulation after completion of each anastomosis procedure is completed by suture closure of distal end of thoracic aorta immediately below end to side anastomosis of Dacron tube (Courtesy of De Bakey M E *et al* J Thoracic Surg 36 393 420 September 1958)

significant in mortality rate Follow-up of several months to over 5 years revealed, with few exceptions, complete relief from symptoms and resumption of normal activities

Group 2, aneurysms of the aortic arch, 50 cases, represents the most serious form of aortic aneurysm because the disease is grave and excision difficult In certain sacciform aneurysms of the aortic arch, tangential excision and aortorrhaphy may be preferable, but in fusiform aneurysms and in sacciform aneurysms with the neck of the sac relatively large, resection of the entire segment with graft replacement is necessary Temporary arrest of aortic circulation at this

level interrupts cerebral blood flow and can produce fatal ischemic damage to the central nervous system The serious strain placed on the left ventricle may cause acute cardiac failure

To overcome these problems, for aneurysms involving the transverse arch or the distal portion of the ascending aorta a temporary shunt is the method of choice With development of the crimped Dacron tube, the bypass principle can be applied as both a temporary and a permanent shunt



Fig 71 —Completed replacement of excised segment of thoracoabdominal aorta and aneurysm with Dacron tube including branches to celiac (*1*), superior mesenteric (*2*) left renal (*3*) and right renal (*4*) arteries (Courtesy of De Bakey M E *et al* J Thoracic Surg 36 393 420, September, 1958)

When the proximal portion of the ascending aorta is involved, cardiopulmonary bypass with use of an artificial heart lung apparatus is required Operative risk is influenced by type and location of aneurysm, age and method of excision Total mortality in the group was 56%, but this figure must be evaluated against the extreme gravity of the natural course of the disease Among surviving patients, results were highly gratifying

Group 3, thoracoabdominal aneurysms, 22 cases is significant because these aneurysms involve the principal vessels to the abdominal viscera Excision is associated with danger of fatal ischemic damage to the liver, kidneys and

gastrointestinal tract consequent to temporary arrest of blood flow to these organs. Syphilis was the predominant cause of the lesion. Hypothermia, controlled extracorporeal circulation and temporary shunts have been used to overcome danger of damaging sensitive abdominal organs Recently, use of the crimped, knitted Dacron tube has permit-

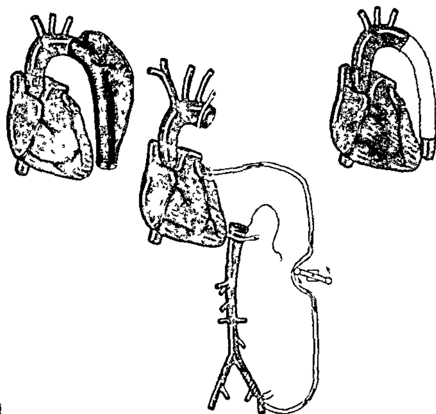


Fig 72—Use of controlled extracorporeal circulation to provide blood flow into aorta distal to site of application of occluding clamps After segment of dissecting aneurysmal process is excised above its origin, false lumen in distal end is obliterated by sewing outer and inner walls together — [illegible] to upper aortic opening is done by conti[illegible] mosis of graft to lower opening in aort[illegible] then done (Courtesy of De Bakey, M E [illegible] tember, 1958)

ted conversion of the temporary shunt into the permanent graft (Figs. 70 and 71). Of 8 operative deaths, 6 occurred in patients over age 60. Results among patients who survived were excellent, and follow-up to 2½ years revealed maintenance of normal activity.

Group 4, dissecting aneurysms, 34 cases, represents one of the most serious forms of aortic disease. Four aneurysms involved the aortic arch; the others arose in the proximal

segment of the descending thoracic aorta. When the dissecting process begins in the ascending aorta, the procedure consists of creation of a re-entry into the true aortic lumen above, with obliteration of the false passage below. Though this obviously is not curative, it diminishes likelihood of rupture above and restores normal aortic circulation below. For lesions arising in the descending thoracic aorta, a more

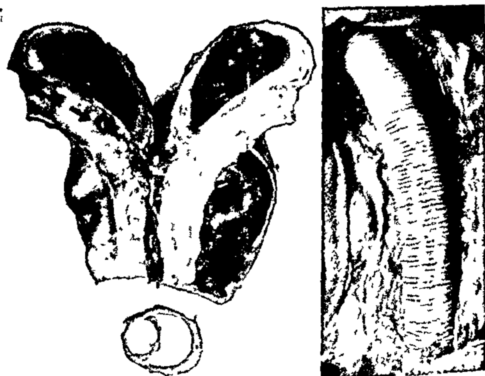


Fig 73 (left) —Sagittal section of resected segment of dissecting aneurysm showing gross pathologic features of lesion Arrow indicates intimal tear through which [illegible] n Cross section at bottom of photograph [illegible] vith smaller lumen and larger false lumen

of segment of aorta and dissecting aneu

(Courtesy of De Bakey, M E, et al J Thoracic Surg 36 393 420 September, 1958)

curative type of operation may be used, i e , excision of the segment involved in the origin of the dissecting process and replacement with graft (Fig 72) When the dissecting process is not well localized, the proximal portion is excised, the false passage below is obliterated by suture of the inner and outer wall and aortic continuity is restored by graft (Figs. 73 and 74). Of 30 patients so treated, 8 died. Age did not seem to be significant in mortality, but hypertension was

highly significant. No deaths occurred among patients considered normotensive. Follow-up to 3½ years revealed that most surviving patients had resumed normal activity.

Surgical Treatment of Aortic Dissecting Aneurysm. The thoracic approach advocated by De Bakey and co-workers for recent dissecting aneurysm, before onset of peripheral dissection, has yielded 10 survivors among 17 patients described in the literature. Masauki Hara and James H. Grow-

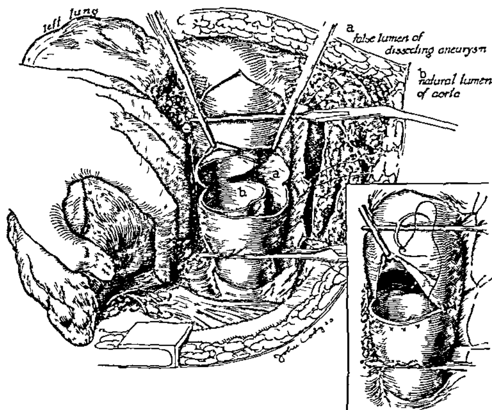


Fig 75.—Operative procedure (Courtesy of Hara, M, and Growdon, J H Angiology 9 233 237, August, 1958)

don[8] (Univ. of Arkansas) observed 4 patients with this disease Two underwent De Bakey's fenestration operation and a third died while awaiting induction of anesthesia. Operation was not recommended in the fourth because of progressive renal failure. One patient has survived 30 months after operation; the other died after readmission, with signs of congestive heart failure, about 2 months after operation.

Woman, 56, semicomatose, was hospitalized in a shocklike state

(8) Angiology 9 233 237, August, 1958

which had followed a sudden excruciating pain in the midsternal and left anterior chest area 3 days before Blood pressure stabilized at 140/90 The heart was enlarged, with a loud systolic murmur A serologic test for syphilis was positive A chest film showed dilation of the ascending and transverse aorta and elongation and tortuosity of the descending aorta An ECG revealed incomplete atrioventricular block and ischemic effect and changes suggestive of left ventricular hypertrophy

Thoracotomy was performed on the 10th day The descending aorta was incised on its lateral half 10 cm above the diaphragm revealing a dissecting aneurysm which was circumferential except for a 1 cm segment on the medial wall The inner lamina of the aneurysmal channel was divided transversely, including the previously uninvolved segment A few small clots were present in the false lumen Overlapping interrupted mattress sutures were placed so as to obliterate the distal false passage (Fig 75) A sizable rim of free margin of the inner wall of the proximal side was excised to provide re entry into the aortic lumen The incision in the aorta was closed by approximating the proximal edge to the reconstituted full thickness of the inferior margin with a continuous suture of 4 0 silk Convalescence was uneventful except for accumulation of fluid in the left pleural cavity, which gradually disappeared The patient left the hospital 18 days after operation and was well 30 months later

This limited experience supports previously expressed views that early operation is indicated in recent dissecting aneurysms Mortality of dissecting aortic aneurysm in the first 30 60 days is 75 90%, about 25 50% of patients die within the first 48 hours Hence the need for surgical treatment is most pressing in the acute phase of the disease

Pathogenesis and Significance of Poststenotic Dilatation in Great Vessels were studied by Francis Robicsek, Paul W Sanger, Frederick H Taylor, Roberto Magistro and Egidio Foti[9] (Charlotte N C, Mem'l Hosp) by clinical observation and hydrodynamic experiments Poststenotic dilatation is a hemodynamic paradox According to the general laws of hydrodynamics, if a closed system is constricted at a circumscribed area, the pressure rises above the stenosis and decreases below it When the diameter of a great blood vessel is abruptly diminished, the same changes occur The blood pressure rises proximally to the stenosis, but after the narrowing it becomes pathologically low

On consideration of the distensibility of blood vessels, it appears reasonable to assume that in the prestenotic area the vessel should dilate and in the low pressure poststenotic

(9) Ann Surg 147 835 844 June 1958

section, the diameter should become smaller The contrary actually happens, as the vessel dilates immediately after the stenosis, sometimes to several times its original diameter This phenomenon is common in aortic coarctation, pulmonary stenosis, aortic valvular stenosis, etc

In direct catheterization studies and model experiments, local increased pressure in the poststenotic region was not found Therefore, the authors believe that the origin of poststenotic widening cannot be explained by elevation of lateral pressure below the level of the stenosis Hydrodynamic studies showed that the turbulent flow and, perhaps more important, cavitation are the factors causing severe injury of the vessel wall These factors act more severely when stenosis is abrupt Poststenotic dilatation is an important sign in differential diagnosis between stenosis involving a short or a long segment of a vessel

Poststenotic dilatation is a favorable factor in blood circulation because it improves blood flow below the level of the stenosis This process may be compared to the function of the so called water suction pump This theory is supported by the observation that collateral vessels entering the dilated section *immediately below the stenosis generally* are dilated to a high degree, thus indicating increased flow

Atherosclerotic Changes in Grafts of Thoracic Aorta Robert S Flom, Robert B Benjamin, Charles E Turbak, Lloyd D MacLean and F John Lewis[1] (Univ of Minnesota), with the technical assistance of Mildred Baker and Elizabeth Swyryd, report that an atherogenic diet, which caused moderate increase in serum cholesterol in dogs (average 404 mg, with normal being 162 mg/100 ml), resulted in severe atheromatous degeneration in aortic graft replacements of Ivalon and homografts Minimal degeneration occurred in grafts of nylon and Orlon On gross evaluation of the grafts and rating from 0 to 4 on the basis of increasing atheromatous change, the host aorta was 0, Orlon 0 75, nylon 1 33, homografts 2 45 and Ivalon 2 8 All grafts were placed in the thoracic aorta in series as aortic replacement in a single dog, this allowed *comparison of degenerative processes* in grafts under almost identical conditions

Degree of degeneration, as assessed by observation of pig-

(1) Surgery 44 356-360 August 1958

which had followed a *sudden* excruciating pain in the midsternal and left anterior chest area 3 days before. Blood pressure stabilized at 140/90. The heart was enlarged, with a loud systolic murmur. A serologic test for syphilis was positive. A chest film showed dilation of the ascending and transverse aorta and elongation and tortuosity of the descending aorta. An ECG revealed incomplete atrioventricular block and ischemic effect and changes suggestive of left ventricular hypertrophy.

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Degree of degeneration, as assessed by observation of pig

(1) Surgery 44 356 360 August 1958

mentation, ulceration, calcium deposition and plaque formation, was not correlated with elevation of serum or tissue cholesterol over the range studied (150 900 mg/100 ml) Some dogs with comparatively low blood cholesterol had 4+ changes in the graft, whereas others with consistently high blood cholesterol levels had 1+ alterations The induced hypercholesterolemia had no observed effect on the host aorta over the period of study (average cholesterol *feeding period, 49 weeks*)

► [It is not surprising that the degree of atherosclerosis observed in this study did not correlate with the concentrations of serum or tissue cholesterol for the authors recorded atheromatous change when any type of degenerative change was present Several types of degenerative or retrogressive changes including ulceration fibrous plaques and *calcification may* occur in grafts when animals are not
and a high concentration of serum or
their development In our opinion the
We have limited this term to refer to a
those observed in the human with foam cells and cholesterol clefts Using the term in this restricted sense, we have observed a correlation between the serum cholesterol concentration and atheromatous changes—Ed]

Development of Atheroma in Arteries Subjected to Experimental Thromboendarterectomy was studied by Paul F Gryska[2] (Harvard Med School) A series of animals subjected to experimental aortic intimal resection were rendered hypercholesterolemic during regeneration of the aortic wall *In all the animals killed*, the area of intimal resection was patent, with no evidence of constriction One specimen showed an area of roughened intimal surface resembling minor stalactites, but all of the other specimens were smooth, glistening and translucent so *that the silk* sutures could be seen easily through the newly formed intimal surface All the specimens showed a relatively normal aorta, except for the segment of regenerated endothelial surface In the area of the regenerated endothelial surface *in all the* animals were areas that showed varying degrees of distinct atheroma grossly These appeared as rounded or irregular streaked areas often raised, yellow orange plaques, ranging in size from 0 1 to 2 cm Microscopically, these areas stained heavily with sudan black and appeared to be only in the newly formed collagen layer These appeared as well localized deposits of lipid and in other areas showed up as a diffuse lipid deposition throughout the newly formed collagen layer With this relatively low level of hypercholesterole

(2) Surgery 45 655 660 April 1959

mia, none of the other major arterial trunks examined, including the coronary, aorta, intercostal, lumbar, iliac and femoral arteries, showed any atheroma formation or sudanophilia, grossly or microscopically.

There was no correlation between serum cholesterol levels, time between operation and start of diet and degree of atheroma. Mural thrombosis probably was a precursor of atheroma formation in some instances.

In clinical practice, the natural question that arises as a result of these observations is, "How significant is lipid deposition in patients who have had thromboendarterectomy for their occlusive atherosclerosis?" Thromboendarterectomy is done in patients in whom humoral factors are unchanged postoperatively and there is an added predisposing local arterial factor as a result of the operation

The opportunity to study arterial segments in patients who had thromboendarterectomy many years previously is obviously needed These observations should not be considered as a deterrent to the operation, since the good results of the operation far outweigh its atherogenic possibilities Thromboendarterectomy remains a useful tool in atherosclerotic occlusive disease.

New Type of Vessel-Suturing Apparatus is described by Kiyoshi Inokuchi[3] (Fukuoka, Japan).

APPARATUS—The structure (Fig 76) consists of two main parts (1) paired bushings ("clipping" and "supporting") and (2) a pair of hemostatic clamps, each of which is attached lateral to the bushing. Each bushing is made of two half-bushings, completed as a circular bushing b [illegible] The principle lies in U-shaped clips, loca[illegible] their legs directed toward the suppo[illegible] out by a pushing comb, attached to [illegible] surface of the bushing and coming into motion by lever action The clipping surface of the supporting bushing has many holes, corresponding in number to the clips, when clips are driven out into the supporting bushing, their legs are bent in B shape in the corresponding holes. Clips are made of alloyed steel (22A), which guarantees less severe local reaction. Another accessory of the instrument is a knife-edge bar, wedged between the two bushings to prevent destruction of intima when the bushings are pushed together The apparatus is equipped with a dozen bushings, in caliber from 2 to 20 mm, each with a carrier forceps

TECHNIC—The vessel is mobilized from the surrounding tissue. Hemostat clamps are placed on each side of the future anastomosis Half-bushings are adapted to the vessel end The vessel end is turned

(3) A M A Arch Surg 77 954-957, December, 1958

inside out and fixed around the bushing with the fixing clamp. The same procedure is performed on another vessel end. Two bushing clamps are approximated and secured with the bar between them. The clipping lever is pressed, and clips are driven by the pushing comb and run through the vessel wall. Their legs are bent in B form in holes of the supporting bushing and a watertight anastomosis is completed.

Data obtained from many animal experiments and some clinical cases show that the apparatus prevents thrombosis

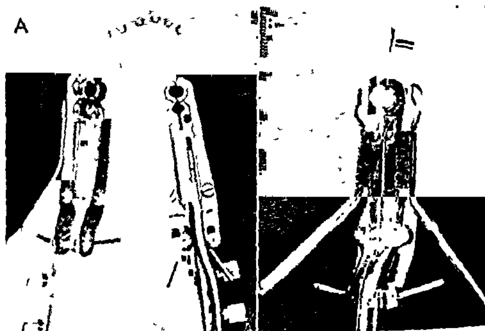


Fig 76.—Clipping part of apparatus *A*, pair of clipping surfaces, *B*, posterior view of clipping bushing. (Courtesy of Inokuchi, K.: A M A Arch Surg. 77 954 957, December, 1958.)

at the line of anastomosis and permits anastomosis or transplantation of small-caliber vessels, which has been impossible with the manual method. Anastomosis can be accomplished much faster than with the manual suture method and is easy and sure.

► [This apparatus is much like that described by Androsov (A M A. Arch Surg 73:902, 1956) and is similar in principle to a host of others developed during the past half century which have been found most useful in decorating a surgical museum They are also useful in reflecting a lack of clinical experience with vascular disease.—Ed]

Technic for Nonsurgical Insertion of Large Polyethylene Tubing into Blood Vessels was developed by Charles T. Dotter and Josef R. Smith.[4]

METHOD.—The bore of the polyethylene tubing to be used deter-

(4) Circulation 18 640 643, October, 1958.

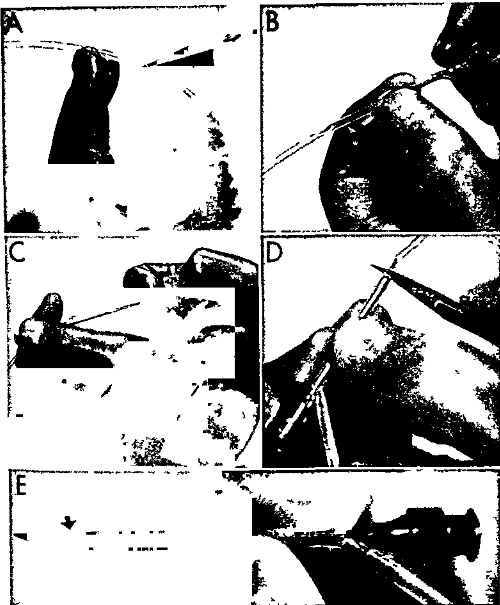


Fig 77 —Technic for nonsurgical inser[illegible]
vessels *A* few inches from one end of t[illegible]
enough to admit needle *B* needle is push[illegible]
wall *C* tube is stretched until its elastic [illegible]
molds around end of needle thinning nea[illegible]
through thinned wall near needle point to [illegible]
ready for insertion (with or without syrin[illegible]
needle shaft shows at arrow To right of needle is tubing (not shown) to be advanced after insertion and removal of guide needle Principal advantage of this method over others is that tubing length and caliber are limited only by patient s anatomy rather than by needle gauge or other special equipment such as sounds (Courtesy of Dotter, C T and Smith J R Circulation 18 640 643 October 1958)

mines the gauge of the guide needle because the guide needle must fit smoothly into the tubing Polyethylene tubing is available in sizes suitable for use with all needle gauges including the 12 gauge Robb-Stei [illegible]

A [illegible] rough one wall of the tubing 4 8 in [illegible] The tip of the needle is introduced through this slit pointing toward the end of the tubing and the needle shaft advanced until the butt of the needle bears on the tubing At this juncture there will be about 4 6 in of tubing projecting beyond the tip of the needle This is grasped by a hemostat and countertraction applied at the base of the needle shaft to forcibly stretch or draw out the tubing This results in thinning of the wall of the tubing at and close to the needle tip The stretched tubing beyond the needle is cut off so as to leave the needle tip projecting slightly beyond the severance site The needle and tubing may be prepared before or after sterilization in either case gloves are necessary for actual insertion into a blood vessel

Insertion is facilitated if after procaine a small (1 2 mm) nick is made in the patient s skin over the desired vessel If this is a vein it should be distended by applying a tourniquet When blood issuing from the needle indicates an intraluminal position of its tip the needle and its surrounding jacket of tubing are advanced as far as possible within the lumen The sensation of resistance giving way may signify entry of the tubing into the vessel Thereafter the needle (alone) is removed care being taken not to retract or otherwise dislodge the tubing in the process After the needle is out the tubing is advanced as far as purpose dictates and taped in place on the forearm Arterial cannulation by this or any other method demands higher degree of competence than does venipuncture

In eliminating the need for surgical exposure of the vessel to be cannulated time is saved and the possibility of wound infection or vascular damage is reduced

Etiologic Mechanisms in Development of Collateral Circulation were studied by James N Winblad Keith Reemtsma Jean L Vernhet Louis P Laville and Oscar Creech Jr [5] (Tulane Univ) in 93 extremity preparations in 49 dogs and 31 patients with occlusive peripheral vascular disease The methods used were intra arterial pressure tracings arteriography cinefluorography tissue P_{O_2} and perfusion of a major artery distal to occlusion with saturated and unsaturated blood After acute occlusion of the superficial femoral artery in the dog pressure proximal to the occlusion site did not rise Drop in pressure distal to the site of occlusion to a nonpulsatile level between 35 and 60 mm Hg was consistently noted During the first 4 6 seconds after acute occlu

(5) Surgery 45 105 117 January 1959

sion, pronounced pressure gradient existed across to the site of occlusion

Arteriography and cinefluorography showed that collateral flow developed simultaneously with onset of occlusion Within the first 4 6 seconds after occlusion, when distal pressure was nonpulsatile, collateral vessels were observed to arise from the major vessel and its branches proximal to the occlusion site About 6 seconds after occlusion, when the pulse contour in the distal vessel became pulsatile, collateral vessels originating proximal to the site of occlusion were noted to communicate with similar vessels that joined the arterial trunk distal to the site Within 3 5 minutes after occlusion, when anterior tibial pressure reached a maximal level, collateral circulation, as shown by arteriograms and cinefluorograms, also was maximal

In investigating anoxia of tissues distal to the site of occlusion, the maximal drop in tissue Po_2 was noted about 1 minute after acute occlusion, whereas maximal fall in pressure was noted instantaneously Perhaps this discrepancy may be partially explained by the prolonged equilibration time of the bare platinum electrode used to record tissue Po_2 To evaluate the importance of anoxia in development of collateral circulation, an experiment was devised to perfuse the extremity distal to the site of occlusion with saturated and unsaturated blood on different occasions, under these conditions no effect on development of collaterals was noted

Clinical studies support these experimental observations In the presence of a significant pressure gradient across an area of obstruction, an extensive collateral network functions to bridge the obstructed segment Restoration of blood flow and pressure by thromboïntimectomy or bypass causes rapid decrease in the size of these collateral vessels An intra-arterial pressure tracing obtained distal to an obstructed segment appears to be correlated with the size of the collaterals Such tracings have often proved to be better guides of collateral circulation than arteriograms In general, patients who showed high pressure (75-90 mm Hg) in pedal arteries were found to have excellent runoff When pedal artery pressure was low (15-50 mm Hg), another tracing was made immediately below the level of occlusion

In such patients, when pressures just distal to occlusion are about equal to pressure in the foot, the runoff has proved adequate In patients who show significant drop in pressure between the area just distal to the occlusion and the foot the runoff appears impaired

Anatomy of Collateral Circulation was studied by Edward A Edwards[6] (Harvard Med School) Angiographic and other data help to clarify the definition of collaterals the degree of vascular isolation of various structures, the collaterals in actual use and their effectiveness A collateral path is one that bridges an obstruction in a vascular trunk Usually it consists of a vessel, or vessels, coursing parallel to the trunk, meeting and discharging blood into a vessel that has branched from the trunk below the obstruction and has run proximally, in a recurrent direction Whether or not a particular artery will function as a collateral must be determined by experimental and clinical evidence but it is reasonable to consider as potential collaterals vessels that course proximally and distally, parallel to the obstructed trunk

Collaterals should be differentiated from the ultimate vessels that lie distal to the occlusion and that may be open or occluded A second vascular system, as in the lung, heart or liver, constitutes a supplementary variety of collateral It may be ineffective because of differences in pressure or content Bypassing an organ may be extremely harmful, as when systemic diversion prevents the liver from acting on portal blood

The vulnerability of an organ or part to vascular occlusion depends considerably on the number of sources of its supply and on presence or absence of connections with neighboring vessels or between the branches within the part Special vulnerability to ischemia exists in an area of junction of branches derived from two or more sources The small vessels in such an area comprise the ultimate portions of a distribution system i e they are acral branches The interventricular septum and adjacent parts of the cardiac ventricles constitute an impressive example

The esophagus near the arch of the aorta and the pulmonary roots is noted as an area of poor healing after surgery

(6) Surg Gynec & Obst 107 183 194 August 1958

It is a zone of junction between branches of the inferior thyroid, bronchial and left gastric arteries

The degree of vascular isolation of an organ may differ from that of its constituent parts

One channel of an anastomotic system may be long or wide at the expense of the other vessels With such unbalance, occlusion of a preponderant artery occasions more ischemia than occlusion of the diminutive vessel Effectiveness of collateral systems depends on size of the anastomoses, occlusion pattern in regard to collateral involvement, functional needs of the tissue and general factors affecting blood flow and blood content In at least one paired organ —the kidney—total necrosis of a single member is less harmful to the patient than survival of the organ with reduced arterial or venous circulation

Adjustment to vascular obstruction in the liver, lung and heart involves connections between systemic vessels and vascular circuits of specialized nature The term "supplementary," rather than collateral, is proposed for such compensatory circulation In all these instances, channels between two systems of diverse nature are demonstrable, yet physiologically the anastomoses entail certain imperfections based on differences in blood pressure, content of blood or direction of flow In general, the multiplicity of veins and their freer anastomoses as contrasted with arteries, allow for less interference with flow after venous occlusion than after occlusion of arteries Nevertheless, collateral inadequacy may be observed, based on details of morphology and the nature of various diseases

One morphologic difficulty is the exceptional importance of a single vein in some regions Examples are the central vein of the retina, the portal, the mesenterics and the renal The closure of such veins causes gross interference with outflow and frequently results in necrosis Other veins are moderately preponderant, e g , the venae cavae, axillary, popliteal and veins of the spinal cord and of the brain Occlusion of such vessels gives rise to necrosis if the part is sensitive and collaterals are missing, as often is true in the spinal cord, or to gross dysfunction, as in the kidney Where conditions are not quite so critical, as in the limbs, moderate dysfunction may result

Branchial Arteritis or Aortic Arch Arteritis New Inflammatory Arterial Disease (Pulseless Disease), Critical Review of 140 cases is presented by Bohdan J Koszewski (Creighton Univ) The cases, reported from Japan, North European countries and the United States, have been designated as pulseless or Takayasu disease, aortic arch arteritis or branchial arteritis

The condition is found in young persons, mostly women and is confined to the big elastic arteries arising from the aortic arch The primary lesion consists in an acute neutrophilic periarteritis, progressing to panarteritis and causing intra arterial thrombosis Later stages are characterized by fibroblastic hypertrophy of adventitia and media, with lymphocytic and plasmacellular infiltration The arteritis builds an integral part of pulseless disease or aortic arch syndrome The characteristic vascular, cardiac, trophic, cerebral, ocular and general symptoms permit its differentiation from other inflammatory and degenerative arterial diseases which may occasionally lead to occlusion of the supra aortic branches

The most characteristic vascular sign is absence of arterial pulsation in neck, head and arms Usually the axillary arteries, as well as the internal and external carotids are occluded by thrombus The brachial arteries and thyrocervical trunk remain intact, building a rich network of anastomoses around the neck and shoulders and supplying the brain with blood through hypertrophic vertebral arteries Vessels and anastomoses can be demonstrated by percutaneous or retrograde aortography Arteries originating from the aortic arch usually show diffuse narrowing, in contrast to the irregular lumen and segmental stenosis in arteriosclerosis Collateral circulation from the aorta and thyrocervical trunk is usually abundant and results in vascular thrills in the neck, palpable pulsations on the chest and crenation of the rib margins Blood pressure and oscillographic pulsations are not obtainable in the arms but may be elevated in the legs Cardiac involvement regularly occurs, and decompensation indicates usually the terminal stage Trophic changes about the head include loss of teeth and hair, ulcers on the lips or tip of the nose and perforation of the nasal

(7) Angiology 9 180 186 June 1958

septum Diminished blood supply causes easy fatigability of the arms and a feeling of coolness in the hands and fingers Occlusion of neck vessels causes dull headache, giddiness, fainting spells, mental impairment and convulsive and auditory disorders Ocular disturbances are photopsia and blurring of vision The disease is usually accompanied by general symptoms, such as low-grade fever, loss of weight, anemia, leukocytosis and a high sedimentation rate Electrophoresis of serum proteins shows increased gamma and sometimes $alpha_1$ globulins

Branchial arteritis is serious, most patients died before the 4th decade Time from onset to death varied from 1½ to 20 years No effective treatment is known, although preliminary results with combined steroid and anticoagulant therapy are encouraging Thrombectomy, sympathetic denervation and grafting of the carotid artery have not been successful If control of the inflammatory process can be effected, vascular surgery should ameliorate the condition

► [This is a most interesting disease and deserves more intensive study Analysis of our experience with over 40 cases in which operative treatment was used has provided certain observations that are contrary to those expressed in this article (see following abstract) For one thing we are inclined to believe that atherosclerosis is the underlying etiologic factor in most of these patients To be sure, an associated and sometimes severe inflammatory reaction may be present but this has also been encountered elsewhere in atherosclerotic occlusive diseases, as for example in Leriche s syndrome. The cause for this inflammatory reaction in some forms of atherosclerotic disease remains undetermined For another, the dismal prognosis reflected in this paper is not in accordance with our experience Contrary to the author s statement that surgical measures such as thrombectomy, sympathetic denervation and grafting of the carotid artery have not been successful' our results with surgical treatment consisting of thromboendarterectomy and bypass grafts have been highly successful with restoration of normal circulation in all cases —Ed]

Surgical Considerations of Occlusive Disease of Innominate, Carotid, Subclavian and Vertebral Arteries are presented by Michael E De Bakey E Stanley Crawford, Denton A Cooley and George C Morris, Jr [8] (Baylor Univ) Arteriography was performed in 174 patients with arterial insufficiency of the cerebrum and upper extremities Extracranial arterial occlusion was demonstrated in 73 (42%) patients, 63 of whom were operated on Of the 115 lesions occurring in the latter patients and located in the internal carotid, vertebral, innominate, common carotid and sub

(8) Ann Surg 149 690 710 May 1959

clavian arteries, 88 were explored surgically, and 75 obstructive lesions that occurred in 53 patients were segmental in nature and amenable to restorative operation. The other patients had extensive complete occlusion of the internal carotid or vertebral arteries, and in view of the duration of occlusion, these patients were not considered operable

The proximal forms of the disease were evident clinically

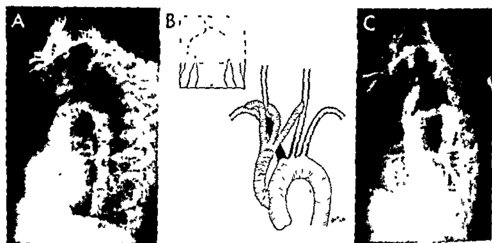


Fig. 78.—Application of bypass method of treatment in multiple involvement of vessels arising from aortic arch *A*, aortogram before operation showing complete occlusion of innominate artery and incomplete occlusions of left common carotid and left subclavian arteries. *B*, location of incisions, extent of occlusive lesion (in black) and bypass graft. *C*, postoperative restoration of circulation through graft (Courtesy of De Bakey, M. E., *et al.*, Ann. Surg 149:690-710, May, 1959.)

by the manifestations of arterial insufficiency of the cerebrum and upper extremities. Distal occlusions were manifested by cerebral arterial insufficiency. Because of the limitations of accurate localization of the lesion on clinical grounds, all the patients were studied by arteriography. Lesions occurring in the great vessels arising from the aortic arch were operable regardless of the location and extent of occlusion (Fig. 78). Incomplete occlusions of the internal carotid and vertebral arteries were similarly amenable to operation. Complete occlusions of the latter vessels were rarely operable unless explored soon after onset of symptoms.

Treatment was directed toward restoration of normal circulation, and to achieve this objective, two types of procedures were used: endarterectomy and end-to-side bypass graft. Endarterectomy was used in the treatment of well-localized lesions (Fig. 79) and the more extensive occlusions were bypassed (Fig. 80), using a suitable arterial sub-

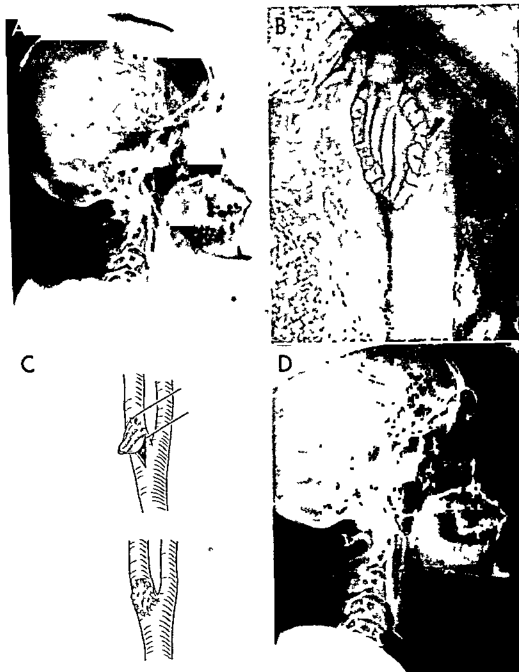


Fig 79 —Internal carotid artery occlusion showing method of applying patch in arterial closure after endarterectomy *A*, preoperative arteriogram showing partial occlusion of right internal carotid artery *B* at operation, with patch in place *C*, method of applying patch *D* postoperative restoration of circulation (Courtesy of De Bakey, M E, *et al* Ann Surg 149 690 710, May, 1959)

stitute Endarterectomy was performed in 37 lesions and graft bypass in the treatment of 38 lesions Temporary shunts were successfully used in patients with contralateral

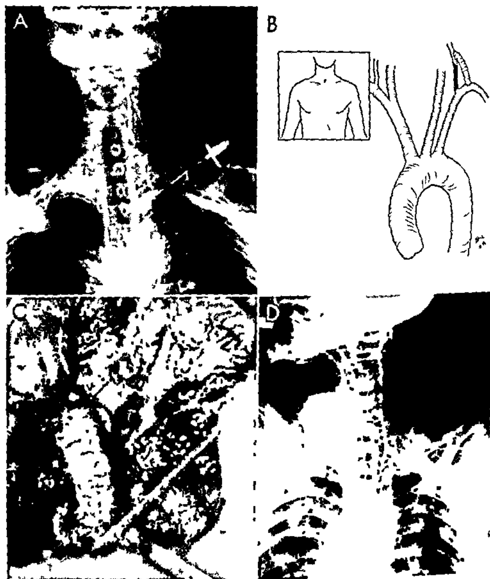


Fig 80 —Application of bypass method of treatment in vertebral artery occlusion *A* preoperative arteriogram showing segmental complete occlusion of vertebral artery *B* location of incision (inset), extent of occlusion (in black) and bypass graft *C* at operation, showing end to side anastomosis of graft to subclavian artery proximal to occlusion and to vertebral artery distal to occlusion *D* functioning bypass graft after operation (Courtesy of De Bakey, M E *et al* Ann Surg 149 690 710, May, 1959)

complete occlusions of the internal carotid artery (Fig 81) Pulsatile circulation was restored in the treatment of 72 lesions Circulation was restored in all patients with lesions involving the great vessels arising from the aortic arch, 97% of those with operable lesions of the internal carotid artery and 60% of those with occlusions of the vertebral artery

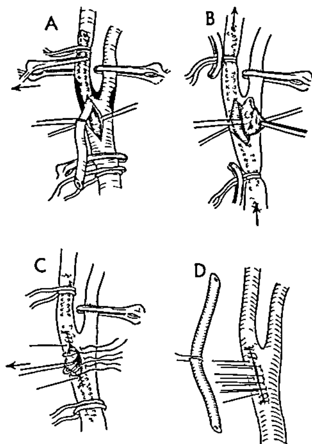


Fig 81 —Endarterectomy, using internal shunt *A* longitudinal incision is made over or immediately proximal to lesion and flexible tube is inserted each end separately, as in insertion of T tube *B*, with bleeding in region of operation controlled by tightening tapes previously placed around artery proximal and distal to arterial opening, endarterectomy is performed by entering cleavage plane between disease and normal outer layer of artery and removal of atheromatous mass *C*, partial closure of arterial opening is performed at both ends of incision and interrupted sutures are placed but not tied, in rest of incision Removal of shunt is started by traction on string tied to center of tube *D*, after removal of shunt, circulation is immediately restored in artery and bleeding controlled by placing traction on sutures that are subsequently tied (Courtesy of De Bakey, M E, *et al* Ann Surg 149 690 710, May, 1959)

All with lesions of the great vessels were completely relieved and most of the patients with lesions of the internal carotid and vertebral arteries were relieved or improved.

Cerebral Ischemia of Central Origin: Relief by Subclavian-Vertebral Artery Thromboendarterectomy. William R. Cate, Jr, and H William Scott, Jr[9] (Vanderbilt Univ.) report a case of a variant of the aortic arch syndrome.

Man, 49, had a variant of the aortic arch syndrome, produced by atherosclerotic occlusion of the origins of the left subclavian and vertebral arteries Symptoms referable to arterial insufficiency of the

(9) Surgery 45 19 31, January, 1959

left upper extremity were present, but those of greatest concern to the patient were related to associated cerebral ischemia

Arteriographic study of the aortic arch using a catheter passed via a femoral artery, showed occlusion of the left subclavian artery at its origin (Fig 82) and patency of the other branches of the arch and both internal carotid arteries Operation was deferred but was undertaken 3 months later because of the patient s continued disability

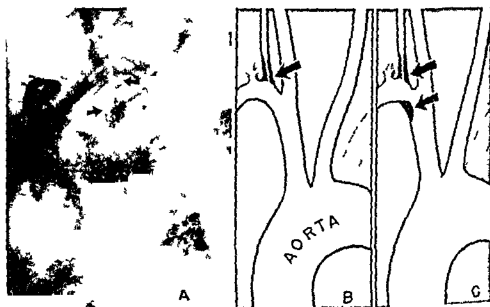


Fig 82.—*A* retrograde aortogram Arrows point to narrowing of origin of right
vertebral artery and plaque (pre
tery Left subclavian (and vertet
origin of right vertebral artery
artery (*lower arrow*) (Courtesy
45 19 31 January 1959)
of *innominate* ar
wing narrowing of
que in innominate
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and the authors increasing awareness of the importance of the vertebral arteries in the cerebral circulation even though intracranial occlusive processes could not be entirely excluded

Operation was carried out under endotracheal anesthesia through an incision that extended upward in the neck along the anterior border of the right sternocleidomastoid for about 3 in, down the midline of the sternum to the 3d intercostal space across the sternum with division of the left internal mammary vessels into the 3d left intercostal space for about 6 in and along the left clavicle with subperiosteal resection of its medial half The ensuing dissection exposed the left side of the aortic arch and the left subclavian and vertebral arteries The proximal left subclavian artery was completely occluded by a hard atheromatous plug at its origin from the aorta for about ¾ in The origin of the left vertebral artery was occluded firmly for about ¼ in Thromboendarterectomy was performed (Fig 83) through an incision in the subclavian artery extending from the distal point of occlusion to a point opposite the origin of the vertebral artery The same procedure was repeated in removing the

atheromatous obstruction from the origin of the subclavian artery. When the constricting devices were removed, after suturing, excellent pulsatile flow without thrills resulted in the arteries.

Strong pulsations in the left radial artery were palpable immediately after operation. Cerebral symptoms disappeared, with return of ability to read, normal gait, absence of headaches and dizziness and

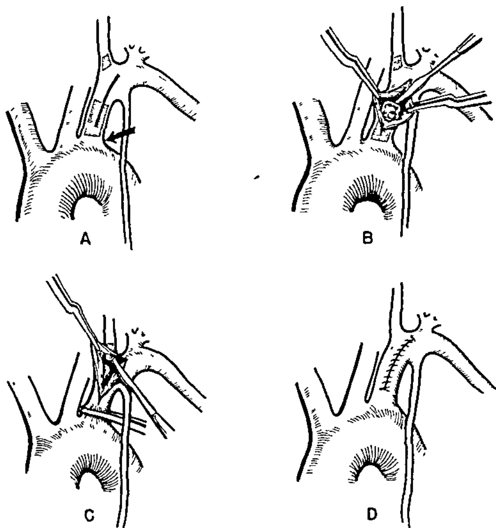


Fig 83.—Thromboendarterectomy of occluded left subclavian and vertebral arteries Sequence is in error in that left vertebral artery was cleared first (Courtesy of Cate, W. R., Jr, and Scott, H W, Jr. Surgery 45 19 31, January, 1959.)

no difficulties of memory. Repeated examinations have shown that the blood pressure in the upper extremities is equal and normal. The patient returned to normal vigorous business activities and 9 months after operation stated that he felt better than in 10 years.

Prompt relief from cerebral symptoms obtained in this patient by the re-establishment of patency in the left vertebral (and subclavian) artery alone emphasizes the impor-

tance of preoperative and operative evaluation of the status of vertebral arteries in the surgical approach to cerebral ischemia

► [Vertebral artery obstruction is indeed a factor in the clinical problem of cerebral ischemia In our experience with a series of 70 patients having clinical manifestations of basilar artery insufficiency arteriography revealed the presence of extracranial vertebral artery occlusion in 42 (60%). A high
proportion of patients with
involvement and as in the
have associated occlusive le
innominate or subclavian arteries

Fortunately these lesions are frequently discrete and well localized to the origin of the vertebral arteries and therefore are amenable to operative treatment Thus in our series of cases normal circulation was successfully restored in about 90% by means of trans subclavian endarterectomy or endarterectomy with graft angioplasty.—Ed]

Surgical Therapy of Acute Upper Extremity Arterial Occlusion gives better results according to William E Trumbull Masashi Uriu and Beryl D Averbook[1] (Univ of California Los Angeles) than conservative management even in poor risk patients Thromboembolectomy plus anticoagulants results in prompt return of peripheral pulses and prevents thrombus propagation lessening the possibility of limb gangrene

Technics.—In patients in whom the site of block is axillary an incision is made just below and parallel to the clavicle The dissection is carried down to the pectoralis major and the clavicular portion is split The upper medial portion of the pectoralis major is detached from the sternum and clavicle The coracoclavicular fascia is incised the axillary vein mobilized and the axillary artery exposed Proximal and distal control is obtained and thromboembolectomy is carried out through a small arteriotomy incision Occasionally it is possible to express a clot by milking toward the arteriotomy so that distal backflow is obtained In some instances satisfactory evacuation of the distal axillary artery may necessitate exposure of the brachial artery With the second exposure it is also possible to express a clot toward the axillary arteriotomy

In situations requiring brachial artery exploration incision is made over the upper medial aspect of the arm and is carried down through the subcutaneous fascia The median nerve is identified overlying the artery and is isolated and retracted The artery is mobilized and after distal and proximal control a small arteriotomy incision is made over the embolus which is then removed (Fig 84) After removal of the thromboembolus good distal backflow should be obtained After removal of the clot a polyethylene catheter is inserted distally and a weak heparin solution is instilled The arteriotomy site should be irrigated with a weak heparin solution and the

(1) Ann Surg 149 388 394 March 1959

arteriotomy closed with arterial silk. After closure is completed, heparin is administered intravenously. Because of heparinization and the possibility of extravasation, a small Penrose drain should be inserted and the wound closed in layers.

In arteries in which there is intimal thickening and secondary thrombosis, thromboendarterectomy may be necessary.

If a thrombus re-forms, distal arteriotomy with aspira-

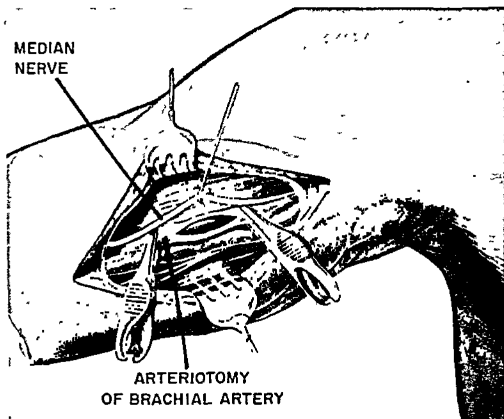


Fig 84—Exposure of proximal brachial artery Brachial arteriotomy has been performed and occluding embolus is shown in situ (Courtesy of Trumbull, W. E, *et al*: Ann Surg 149 388 394, March, 1959)

tion of the re-formed clot should be performed without hesitation. The original arteriotomy should not be reopened; this results in a ragged edge of intima with resultant compromised lumen if closed at that site.

Lost limbs are probably due to distal propagation of the thromboembolus, which results in loss of collateral circulation. Many observers have set arbitrary limits on duration of the occlusion before performance of arteriotomy. It is now recognized that operation combined with operative and postoperative anticoagulant therapy gives good results up to 48 hours after acute onset.

Use of Autografts to Bridge Defects in Arteries of Coronary Size Experimental Study was made by Norman H Baker, John W Kirklin, John H Grindlay and Jesse E Edwards[2] (Mayo Clinic and Found) in grafts of small arteries in specimens from 20 mongrel dogs The grafts were autogenous, with average outside diameters of 3 04 mm and inside diameters of 1 6 mm Gross and histologic examinations were done 12 66 days after the initial procedure The grafts were patent in 80% and in all instances remained viable Histologic appearance of the graft was similar to that of the host artery

Various types of anastomoses have been advocated through the years by vascular surgeons The authors applied an everting, running mattress suture of 5 0 silk for most anastomoses Bleeding from the suture line was slight and the procedure was as easily accomplished as the over and over type of anastomosis The type of anastomosis seems not so important as the way in which it is done Careful placement of stay sutures with minimal tension, adventitial debridement, oiling the suture, keeping the graft moist and careful placement of the suture line with the proper tension are a few of the small but important details necessary for good technic and satisfactory results

Small autogenous arterial grafts may prove to be of value in disease of the coronary arteries, in cerebral aneurysm and in thrombosis of the mesenteric artery Apparently the size of these vessels is more of a psychologic than a real barrier to their use as grafts in anastomosis of small arteries

Prognosis in Peripheral Arterial Insufficiency Associated with Claudication or Ulceration was analyzed by Herbert J Robb, John W Bowden, Rudolph Castellani and Charles G Johnston[3] (VA Hosp , Dearborn, Mich) in 140 patients with symptomatic peripheral vascular occlusive disease Ulceration or early gangrene was present in 55, of whom 25 were diabetics In these patients amputation rate was 71%, and 42% died of associated disease within 3 years Ulcers healed after surgical treatment in 11%

Claudication alone was present in 85 patients, of whom 57% could walk less than 1 block, 21% 1 2 blocks and 22%

(2) Surgery 44 548 553 September 1958
(3) A M A Arch Surg 76 857 862 June 1958

2 or more blocks before claudication occurred After sympathectomy, little change was noted in percentage of patients who could walk each distance (Fig 85) Of all patients, 18% felt that they could walk farther after sympathectomy, 18% walked a shorter distance and 64% were unimproved Greatest improvement occurred in those who could walk 2 or more blocks before operation When claudi-

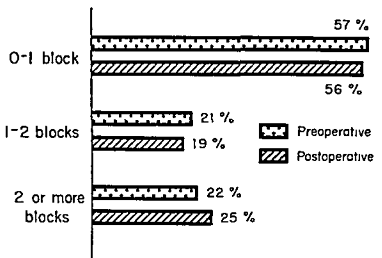


Fig 85—Onset of claudication before and after sympathectomy (Courtesy of Robb H J *et al* A M A Arch Surg 76 857 862 June 1958)

cation alone was present amputation rate was 15% and mortality within 3 years 18%

Possibly, diabetics as a group did less well than nondiabetics, but average age of diabetics was 11 years higher and ulceration occurred in 69% (as compared with 29% of nondiabetics) That the nondiabetic with ulceration did just as poorly as the diabetic with ulceration, who was on an average 13 years older, indicated that it was not diabetes or age alone but ulceration that gave the poorer prognosis

Of patients with ulceration, 58% were still alive an average of 3 years after lumbar sympathectomy, whereas 82% of those with claudication were still alive In most patients the extremity was warmer objectively and subjectively after operation, but only 31% felt that function of the leg had improved Of those with night pain, 16% showed relief from this pain Of the entire group, 20% returned to 75% of full time employment

Experience with about 90 bypass arterial grafts, many ex-

tending from the common iliac to the popliteal artery, indicated that in selected cases these grafts give much better relief from claudication than does sympathectomy If patients are properly selected, usually those who could walk 1 block show relief from claudication Arterial graft was highly successful in 37 patients who had had sympathectomy Currently, sympathectomy is being reserved for patients who are not candidates for arterial grafting or who have had recurrence due to progressive arterial obstruction after the grafting

Place of Sympathectomy in Treatment of Occlusive Arterial Disease is evaluated by Geza de Takats[4] (Univ of Illinois) Sympathectomy is but one phase of treatment of the total patient If the operation is done for intermittent claudication, caution must be exercised in promising results though well maintained collateral circulation in grade I arteriosclerosis is the most likely to show improvement Patients may expect gradually increasing walking ability during the first 6 12 months Cold sensitivity due to ischemia is definitely lowered Claudication in higher grades of arteriosclerosis has not been influenced at all Ulceration and terminal patches of gangrene respond remarkably fast to sympathectomy in thromboangiitis obliterans and other lesions showing terminal vascular disease with well maintained collateral circulation proximal to it

Obliterative arteriosclerosis with arteriolar sclerosis responds poorly, if at all In acute arterial occlusions there is no place for sympathectomy if the embolus can be aspirated or the thrombus reamed out In treating subacute or late stages of acute arterial occlusion, sympathectomy does relieve rest pain and may improve circulation if patency of the main arterial pathway cannot be fully restored Protection of an ischemic limb from gangrene is the object of sympathectomy and no clear cut help from claudication can be expected

Definite indication for prophylactic sympathectomy exists under these conditions (1) when a single lower extremity is afflicted with vascular disease after the other extremity has been amputated especially in arteriosclerotic and diabetic patients, (2) before definitive surgery of aneurysms whether

(4) A M A Arch Surg 77 655 676 November 1958

aortic, iliac, femoral or popliteal, (3) before or simultaneously with all endarterectomies and vascular grafts, (4) in diffuse arterial disease in which segmental resection, bypass or thromboendarterectomy is futile or doubtful, e g , in widespread aortic or iliofemoral stenoses or short segmental obliterations with short, sturdy collaterals, where sympathectomy alone may increase claudication distance greatly

Because sympathectomy has been combined with physical exercise, drugs and endarterectomy and bypass procedures, its exact value is difficult to define Since it cannot restore patency of a major artery, it can never have the effect of a carefully performed endarterectomy or vascular graft Conversely there are many situations in which these procedures cannot be performed or in which immediate or delayed failure of a restored circulation occurs Such a circulation is devoid of large functioning collaterals and is in great need of sympathectomy Restored main arterial pathways with good peripheral pulses do not necessarily insure adequate muscle flow Sympathectomy here will help by lowering collateral resistance and delivering more blood to the terminal vascular tree

A final consideration is the simple harmless character of sympathectomy Patients in their eighties can tolerate it, and if postsympathetic neuralgia can be eliminated, the procedure has negligible after-effects

Intravenous Abdominal Aortography: Preliminary Report Eugene F Bernstein Richard H Greenspan and Merle K Loken[5] (Univ of Minnesota) developed a technic for intravenous abdominal aortography for use in experimental animals and clinical patients It involves use of a polyethylene cut down tube in the brachial vein, I^{131} circulation time studies, peripheral vascular occlusion, a hand injector and a rapid changing biplane x ray apparatus

Successful radiographic demonstration of the entire thoracoabdominal aorta and its branches down to the popliteal arteries was obtained in 3 dogs Visualization of the carotid arteries and their main branches was obtained in 2 dogs when the head and neck region was x-rayed These studies were performed without the technics of peripheral vascular compression and serial biplane radiography

(5) Surgery 44 529 535 September 1958

The abdominal aorta was visualized in 12 patients, several of whom were over age 50 and had considerable arteriosclerotic disease While the aorta and iliacs were visualized in all, degree of opacity and contrast varied considerably, depending on the status of the cardiovascular system of the individual patient In patients with occlusive arteriosclerosis, circulation time to the abdominal aorta was considerably longer, as demonstrated by the radioactive circulation time studies, and there was more time for dilution of the contrast material No patient with congestive heart failure or atrial fibrillation was examined

The technic should supplant the translumbar method for diagnosis of occlusive and aneurysmal disease of the abdominal aorta and its branches because it eliminates all complications caused by direct aortic puncture It may also be applied equally well to studying the thoracic aorta for aneurysm, coarctation and occlusion

► [While this method has proved generally satisfactory for visualization of the thoracic aorta, our experience with its use for the abdominal aorta and its branches suggests that it does not provide adequate delineation of the vessels to permit precise localization of disease Further improvements in the method will be necessary before it can supplant lumbar aortography —Ed]

Role of Aortography in Determination of Operability in Arteriosclerosis of Lower Extremities was analyzed by Edwin J Wylie and Leon Goldman[6] (Univ of California), who reviewed data on 500 patients With establishment of the direct surgical approach to peripheral arteriosclerotic lesions, visualization of the exact extent of the disease before surgery is of the greatest importance To be of value, the x ray must show clearly the proximal and distal levels of all occluded segments of the arterial tree Equivocal x-ray diagnosis of operability was confirmed on surgical exploration When surgical exploration was done, errors in aortographic interpretation, when encountered, invariably were those underestimating the extent of the disease

Determination of the distal extent of gross disease is paramount for accurate evaluation of reconstructive surgery Familiarity with the characteristics of the collateral vessels at the level of the distal point of the arterial occlusion is particularly important If at any given level of the arterial tree

(6) Ann Surg 148 325 342 September 1958

distal to the proximal level of occlusion, small arteries fill in continuity with the proximal collaterals, but main-stem artery filling is not demonstrated, then the main-stem artery

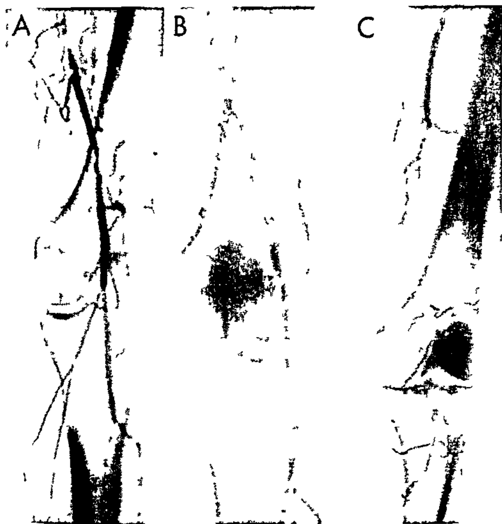


Fig 86—Popliteal segments of aortograms in 3 patients with claudication of calf and absent popliteal pulses showing form of distal disease that contraindicated arterial operation In *A* and *B* patent popliteal arteries distal to segmentally occluded superficial femoral arteries show diffuse intimal disease and additional occlusion of small arteries at popliteal bifurcation If distal end of bypass grafting or thromboendarterectomy had been effected in apparently normal midpopliteal artery in *A* lack of run-off due to occlusion beyond this level would probably have resulted in unsuccessful operation In *C* distal collateral filling in absence of popliteal filling indicates occlusion of entire length of popliteal artery (Courtesy of Wylie E J and Goldman L Ann Surg 148 325 342 September 1958)

is occluded at that level (Fig 86) The degree of intimal disease immediately distal to an occluded segment is recognized as a major factor in local operability In performing thromboendarterectomy or bypass arterial graft high incidence of immediate or late failure of the operation was encoun-

tered by the authors in patients with impaired arterial filling as described

According to the distribution patterns of peripheral arteriosclerosis that have emerged as a result of this study, lesions at the aortic bifurcation level tend to be solitary whereas those below the iliac bifurcation involve in varying degree the arteries of both extremities Anatomically, from the x-ray studies, localization of the lesions can be classified at four general levels those apparently limited to the aorta iliac area, those in the region of the femoral-popliteal segment, those apparently involving aorta-iliac and femoral popliteal segments, and those involving the arterial tree distal to the popliteal artery

Of the 500 patients, 199 (40%) were shown by aortography to have so many or such difficult lesions that direct arterial operation was contraindicated If surgical exploration had been elected as an alternative to aortography, 40% of the patients with inoperable lesions would have required extensive surgery to confirm such diagnosis

Clinical studies are now in progress to determine the relative merits of thromboendarterectomy and the bypass graft procedure for management of occlusive lesions in the femoral-popliteal segment of the arterial tree As far as the aortic iliac artery is concerned, regardless of the extent of the lesion, treatment by thromboendarterectomy has been more satisfactory, except in the presence of an associated aneurysm

Aortography has incurred some complications worth mentioning Renal function was decreased in a small percentage of patients but returned to normal in 2-90 days Fatal uremia occurred in 1 patient 2 weeks after aortography Injection of Urokon® caused damage to the spinal cord of 1 patient at the level of the diaphragm The resulting transient Brown-Sequard syndrome at the level of the 8th thoracic segment cleared in 4 months Bloody diarrhea developed in 3 patients because of intestinal injuries In these 3 patients the needle was observed at the level of the superior or inferior mesenteric artery Most complications can be prevented if injection is done below the renal artery

► [These thoughtful observations by Wylie and Goldman concerning the significance of aortography in determining the operability of atherosclerotic occlusive disease of the lower extremities deserve emphasis While

most of these observations are in accord with our experience, in a few instances we would be inclined to a somewhat different point of view For example the authors believe that thromboendarterectomy is more satisfactory for occlusions of the aortoiliac region regardless of their extent whereas our experience has led us to the conviction that thromboendarterectomy should be used in relatively discrete well localized lesions and that the bypass graft procedure is preferably used in the more extensive lesions Another important consideration emanating from our experience is concerned with determination of operability in patients with extensive occlusive lesions involving both the aortoiliac and femoropopliteal segments In such cases with arteriographic evidence of distal occlusion of the main arterial channel it has been observed that the profunda femoris is usually patent Under these circumstances and despite the fact that the superficial femoral and popliteal arteries are completely occluded these patients should be considered operable since restoration of a pulsatile blood flow into the profunda femoris artery has provided most gratifying improvement in circulation in these extremities This is best achieved by means of a bypass graft from the abdominal aorta above the occlusion to the endarterectomized segment of the common femoral artery opposite the origin of the profunda femoris —Ed]

Surgical Considerations of Occlusive Disease of Abdominal Aorta and Iliac and Femoral Arteries Analysis of 803 Cases observed during the past 5 years is presented by Michael E De Bakey E Stanley Crawford Denton A Cooley and George C Morris, Jr (Baylor Univ) The obstructing lesion in chronic cases is usually well localized and segmental, with a relatively normal patent lumen above and below the occluding lesion Two major groups may be classified, i e , aortoiliac occlusion and femoral occlusion In the former group, 448 patients, 44% showed complete and 56% incomplete aortic occlusion Associated occlusive disease of the peripheral arterial bed was present in 18% and was more frequent with incomplete aortic occlusion Arteriographic

TABLE 1 —RESULTS OF TREATMENT IN AORTOILIAC OCCLUSION

Procedure	Complete Occlusion						Incomplete Occlusion					
			Peripheral Involv		Successful				Peripheral Involv		Successful	
	No Cases	%	No	%	No	%	No Cases	%	No	%	No	%
Excision with graft replacement	69	35	2	3	65	94	71	29	8	11	68	96
Thromboendarterectomy	31	16	4	13	31	100	75	30	18	24	70	93
Excision with graft replacement and bypass	68	34	10	15	66	97	36	14	15	41	33	91
Bypass only	31	16	8	26	27	87	67	27	13	19	66	99
Total	199	100	24	12	189	94	249	100	54	22	237	95

( ) Ann Surg 148 306-324 September 1958

studies are important to provide precise knowledge about location and extent of the occlusive process and thus to permit effective therapy

Treatment of aortoiliac occlusive disease was directed toward restoration of normal circulation by thromboendarterectomy, excision with graft replacement or bypass graft

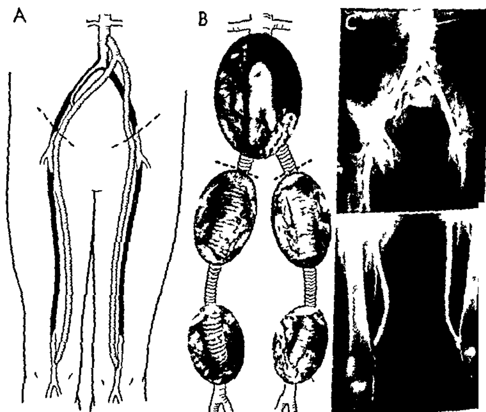


Fig 87 — Bypass method of treatment in aortoiliac occlusion with segmental occlusion of both femoral arteries *A* extent of occlusive lesion (in black) and bypass graft *B* at operation end to side anastomosis of graft to abdominal aorta above occlusion side to-side anastomosis of graft to common femoral arteries and end to side anastomosis of graft to popliteal arteries *C* postoperative aortogram showing restoration of circulation through graft (Courtesy of De Bakey M E *et al* Ann Surg 148 306 324 September 1958)

(Fig 87) Indications for each procedure depend on location extent and nature of the occlusive process and certain systemic factors Lumbar sympathectomy is a desirable supplemental procedure in patients with associated peripheral disease with secondary narrowing or occlusion in the smaller distal arterial bed Results of surgical treatment were excellent (Table 1) Associated cardiac and renal disease was the major cause contributing to the operative mortality of 2 7% Cardiac disease mostly coronary thrombosis, was the pri

mary cause of the 9 deaths occurring 1-30 months after discharge. Long-term results were most satisfactory, recurrent occlusion appearing in only 8 patients 3-27 months postoperatively. In all but 1 of these, who refused operation, suc-

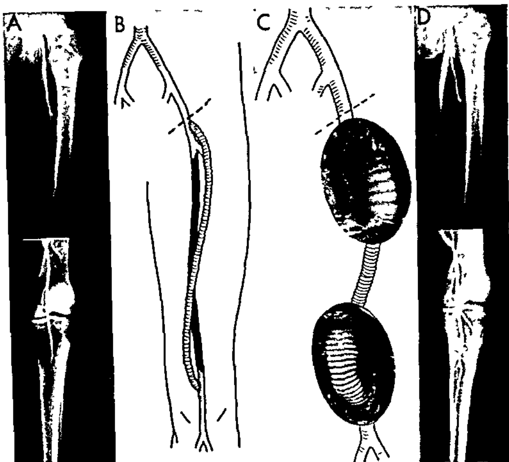


Fig 88.—*A* preoperative arteriogram showing extensive segmental occlusion of superficial femoral artery *B* treatment by bypass graft *C*, at operation, end-to-side anastomosis of graft to femoral artery above and to popliteal artery below. *D*, postoperative arteriogram showing restoration of normal circulation (Courtesy of De Bakey, M E *et al* Ann Surg 148 306 324, September, 1958)

cessful restoration of circulation was obtained by a second operation—a bypass graft.

The nature and extent of pathologic features of femoropopliteal occlusive disease are variable but in general may be classified into (1) those in which the occlusive lesion is quite discrete and well localized, with relatively normal arterial elements above and below the occlusion, (2) those in which the process is more extensive, with involvement of a considerable portion, if not most, of the superficial femoral artery but with patency of the popliteal artery and distal

arterial bed (Fig 88) and (3) those with still more extensive and diffuse obliterative disease extending well down into smaller vessels of the calf *Arteriographic studies are* essential in determining these forms and in application of appropriate surgical treatment The first two types are amenable to surgical treatment directed toward restoration of normal circulation, whereas the third may be best treated by lumbar sympathectomy Thromboendarterectomy may be used satisfactorily in the first type, but in the second the bypass graft is the procedure of choice

Of 353 patients with occlusive disease of the femoral artery (Table 2), about 90% were treated by the bypass graft Excision and graft replacement, used in 19 patients seen

TABLE 2—RESULTS OF OPERATIONS FOR FEMOROPOPLITEAL OCCLUSION

Operation	Number of Cases*	Successful Results: Number	Successful Results: Per Cent
Endarterectomy	17	9	53
Excision and graft replacement	19	16	84
Bypass	317	273	86
Total	353	298	84

*Death occurred in 3 patients or 1% of this series

early in the series, has been virtually abandoned in favor of the bypass graft Endarterectomy is still considered desirable, but its indications are infrequent Despite greater difficulties imposed by the nature of the lesion in this form of occlusive disease compared with that situated more proximally, restoration of normal pulsatile circulation was accomplished in 84% Recurrent occlusion observed in only 14% was noted 3 weeks to 38 months after discharge A second operation was performed in 27 of the 41 patients with late failure, with successful restoration of circulation in 20

Arterial Bypass below Knee. Restoration of pulsatile blood flow in the lower leg is the objective of surgical treatment for segmental occlusive disease of the femoral artery George C Morris, Jr Michael E De Bakey, Denton A Cooley and E Stanley Crawford[8] (Baylor Univ) reached this objective

(8) Surg Gynec & Obst 108 321 332 March 1959

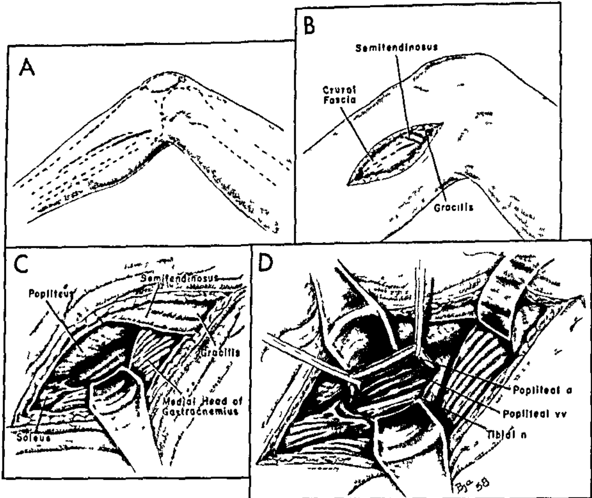


Fig 89 —Anteromedial approach to popliteal artery below knee *A*, incision parallels medial surface of upper tibia *B*, crural fascia is divided distal to semitendinosus tendon and continued inferiorly in line of fascial fibers, with care taken to avoid injury to saphenous nerve which parallels incision superficially *C*, separation of fascial attachments to inferior aspect of semitendinosus and gracilis tendons allows mobilization of these structures superiorly Fascial space thus exposed is bounded by popliteus muscle anteriorly, soleus inferiorly and medial head of gastrocnemius posteriorly *D* retraction of gastrocnemius exposes popliteal artery and veins and tibial nerve (Courtesy of Morris, G C, Jr, *et al* Surg, Gynec & Obst 108 321 332, March, 1959)

Fig. 90.—A, al lon al ortc n e rysm a l exte t of fen oro opl teal ocl ve r cess. B, loc t n l exte t of occlus ve r ce s. C, etl d of surgical correct . D, f ct o g l y s grafts below knees. (Co rtesy of M r G C J t al Surg. G y e & O t 118 3 1 33 March 1959.)

in 86% of 317 patients treated by the following bypass graft technic

TECHNIC.—With the patient's knee moderately flexed, a vertical incision is made just behind the posteromedial surface of the tibia (Fig 89, A) The crural fascia is incised vertically in the line of its fibers, and its attachments to the distal inferior aspect of the semitendinosus and gracilis tendons are separated to mobilize these structures superiorly (*B* and *C*) The medial head of the gastrocnemius muscle is retracted posteriorly to allow entrance into a fascial space in the apex of which are located the distal popliteal vessels and the tibial nerve as they cross the popliteus (*D*) This portion of the popliteal artery lies distal to the inferior genicular arteries, and usually no significant collaterals arise either from this segment or from the posterior tibial artery between the anterior tibial and peroneal arteries Because of the paucity of small branches the artery can be mobilized and brought superficially with good exposure for distal graft anastomosis Though slightly smaller than the proximal popliteal, the infragenual segment is of sufficient caliber for satisfactory graft attachment This segment tends to be better preserved, presumably because it lies distal to the knee and has not been exposed to the chronic trauma of bending

The problems involved are illustrated by the following patient

Man 58 had cold feet and bilateral claudications for 2 years Arteriographic study showed a small aneurysm of the abdominal aorta (Fig 90) The distal two thirds of each superficial femoral artery was occluded, and the proximal portions of both popliteal arteries had multiple arteriosclerotic plaques An the renal arteries was resected and tube was anastomosed end to-end proximally The aortic bifurcation was closed with sutures as a blind proximal segment The day after operation, pedal pulses were absent on the right, although they were bounding on the left The right distal popliteal artery was exposed through an anteromedial infragenual incision The vessel appeared well preserved at this level After this operation, bilateral pedal pulses of excellent quality have persisted

Iliofemoropopliteal Arterial Reconstructions for Arteriosclerosis Obliterans: Factors Influencing Late Patency. Richard Warren and J Leonel Villavicencio[9] (Boston) studied 70 iliofemoropopliteal arterial reconstructions followed for more than a year Incidence of patency of the reconstructed segments was 55% for thromboendarterectomy, 18% for venous autograft and 9% for arterial homograft

Roentgenologic and pathologic study showed the thromboendarterectomized segments to undergo marked reaction

(9) New England J Med 260 255 263 Feb 5, 1959

of fibrosis during the first 6 *months after surgery. If they* survived this period, further reaction did not take place and relative long-term patency could be expected. *In the venous* autografts, similar susceptibility was noted during the first 6 months, presumably resulting from a variety of factors, such as constriction of anastomosis, irregularity of the segment (due to valve stations), taut adventitial bands and external hematomas. If the grafts did not close because of these factors in the first 6 months, relative long-term patency could be expected. *Lesions were noted in half the patients* with arterial homografts. These consisted of mural thrombus, rapid degeneration with calcification, aneurysm and late degeneration similar to arteriosclerosis. Later closures occurred in these segments and in others that showed no lesions, to the extent that no security against closure was gained with passage of time.

There was no relation of the level of serum cholesterol or incidence of other obliterative arteriosclerotic lesions to *these lesions or incidence of closure of reconstructions* Of the limbs in which reconstructions closed, 20% worsened and of these, about half required amputation, which probably would not have been necessary if the reconstruction had not been attempted.

► [The functional results of reconstructive operation for occlusion of the iliac, femoral and popliteal arteries reported here are extremely poor Indeed, were they to be considered characteristic, this form of therapy would have to be abandoned, particularly since amputation was required in about 10% and was precipitated by operation in a little over half of these Fortunately, these results are not characteristic for this form of therapy *For example*, in our experience with treatment *of 1,225* cases of occlusive disease of the lower extremities with follow up studies extending over 6 years, the total mortality was only 1 6%, late difficulties occurred *in only 11% and only 20 patients (1 6%) subsequently* required amputation, all of whom had severe ischemia or gangrenous changes before operation This problem has varied, however, with both type of *operation and location of the lesion Difficulty has recurred in only 6 2%* of our cases with occlusion of either the aorta or iliac arteries, whereas among patients with lesions of the femoral and popliteal arteries this incidence was 20% *In the latter group of cases the highest incidence of recurrence* was associated with excision and graft replacement Particularly significant is the fact that reoperation provided successful restoration of circulation in all but 2 of the 38 cases in the former group of patients with recurrent disease, and in 55 of 64 patients in the latter group *Careful* review and critical analysis of the cases in which there were recurrent difficulties would suggest that these problems are largely preventable, being due to inadequate appreciation of the nature and extent of the underlying disease and certain technical factors including graft material and type of procedure used —Ed]

Three Years' Experience with Peripheral Arterial Grafts of Crimped Nylon and Teflon. W. Sterling Edwards and Champ Lyons[1] (Med College of Alabama) report on 51 such grafts Twelve were replacement grafts for arterial injuries or peripheral aneurysms, all of which functioned satisfactorily Thirty eight bypass grafts were performed for obliterative arteriosclerosis, with acute thrombosis of 7 and late occlusion in 4 A new crimped tube of knitted Teflon was used in the last 7 bypass grafts

Teflon has proved superior to all other synthetics in arterial grafts in animals There has been almost no tissue reaction, healing of the neointima has been rapid, and thus far it is the only fiber tested which has shown absolutely no tensile strength loss in up to 2 years Teflon is one of the most inert plastics yet discovered, it will withstand boiling nitric or sulfuric acid with no chemical change or loss of strength It is extremely unwettable, a highly desirable characteristic in arterial substitutes Nylon absorbs up to 4% unit weight of water, Teflon absorbs none This water-repellent property of Teflon reduces the amount of bleeding for a given degree of porosity, as compared with nylon A certain degree of porosity is essential to allow rapid heal ing and firm attachment of the neointima, since a healed adherent lining is the best insurance against thrombosis Teflon tubes must, therefore, be preclotted with the patient's blood before insertion This is usually done by dipping the graft in a basin containing 20 30 cc of the patient's blood, massaging the tube and allowing blood to coat thoroughly the outside of the graft Removal of the distal clamps, followed by a 30 second wait before removal of the proximal clamp, minimizes blood loss If weeping through the pores is still troublesome, the proximal clamp is reapplied for a few seconds Knitted Teflon is easier to handle and suture than crimped nylon

Acute thrombosis is related usually to stasis of blood in the graft, due to sluggish runoff distally or to technical errors resulting in projecting edges which trap fibrin Early postoperative thrombosis may occasionally be due to compression of the graft caused by the patient's sleeping with the legs crossed or some other mechanical factor More fre-

(1) Surg Gynec. & Obst 107 62 68 July 1958

quently, however, thrombosis in the first few days or weeks is due to partial detachment of the neointima, which swings down and occludes the lumen Therefore early attachment of the lining is desirable Teflon tubes with controlled porosity allow attachment of the lining in 1-2 months compared with nylon tubes in which the fibrin lining becomes healed and secure in 4 6 months

Late thrombosis after 6 months may be due to progression of arteriosclerotic plaques just proximal or distal to the graft Areas of arterial injury, such as those due to artery clamps, are particularly vulnerable locations for further plaque formation Synthetic grafts do not seem to be susceptible to the atherosclerotic changes that have been observed in arterial homografts or long autogenous vein grafts

Clinical Application of New Flexible Knitted Dacron Arterial Substitute is described by Michael E De Bakey, Denton A Cooley, E Stanley Crawford and George C Morris Jr[2] (Baylor Univ) Homografts were first used successfully for direct surgical treatment of various forms of aortic and arterial disease Their major disadvantage lies in the inconvenience associated with their procurement and preparation, they are not available in sufficient quantities to m increasing demands for their use For these reasons, va ous materials, such as Ivalon, nylon, Orlon, Dacron a Teflon have been used

Knitted Dacron may be repeatedly sterilized by autocl ing in the usual manner without weakening the fabric Ti material is available in tubes of various sizes and sha (Fig 91), including secondary branches for ready adap bility to all segments of the major arterial system Becau of the knitted construction of Dacron, it is nonfraying a may be cut with scissors or scalpel at an angle or holes m be cut in its side for anastomosis of branches Dacron m be clamped with arterial clamps without harm to t fabric Its flexibility and elasticity greatly facilitate anatomic and technical application under a wide variety circumstances

Since early 1957, the authors used Dacron graft almost e clusively in treatment of a wide variety of aortic and ar rial diseases Analysis of this experience, which now i

(2) Am Surgeon 24 862 869 December 1958

cludes a total of 737 patients, reveals results that are in general most satisfactory Though insufficient time has elapsed to provide long term evaluation of the functional efficacy of these grafts, follow up over 1-1½ years has been

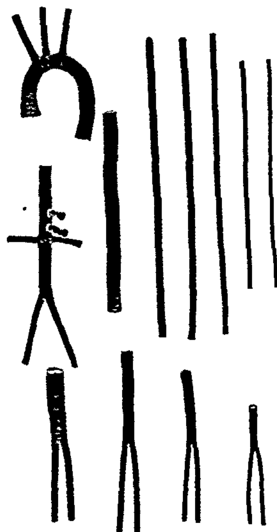


Fig 91—Various types and sizes of Dacron grafts for replacement of different anatomic segments of aorta and peripheral arteries (Courtesy of De Bakey M E *et al* Am Surgeon 24 862 869 December 1958)

most gratifying and has revealed no failures that could be attributed to the graft Comparison of these results (table) with those obtained with other types of synthetic vascular replacements and with homografts indicates that the Dacron graft is superior in all respects Incidence of failures attributable to the graft was significantly less in the Dacron series than in other synthetic graft series An important

RESULTS AFTER USE OF DACRON GRAFTS, OTHER SYNTHETIC GRAFTS AND HOMOGRAFTS DERIVED FROM ANALYSIS OF AUTHOR'S CLINICAL EXPERIENCE

Dacron Grafts	No Cases	Deaths	Graft Failures	Successful
Thoracic aorta				
Aneurysms	51	13(25%)	0	38(75%)
Occlusions	*18*	*1(5 5%)*	*0*	*17(94%)*
Abdominal aorta				
Aneurysms	235	6(2 6%)	1(0 4%)	2[illegible]8 9[illegible]%)
Occlusions	163	1(0 6%)	3(2%)	159 98%)
Peripheral arteries				
Aneurysms	2	[illegible] 7%)	1(4%)	24(89%)
Occlusions	[illegible]43	2(0 8%)	17(7%)	[illegible]4(9[illegible]%)
Total Dacron grafts	[illegible]37	[illegible]5(3 4%)	22(3%)	690 94%)
Total other synthetic grafts	341	[illegible]9(8%)	27(8%)	285 84%)
Total homografts	593	6 (10%)	24(4%)	50 (85%)
Total all grafts	1 6 1	116([illegible]%)	73(4%)	1 482 89%)

factor contributing to the reduction in mortality in the more recent Dacron series is improvement in surgical management resulting from increased experience The fact remains, however, that mortality in the Dacron series is significantly lower than in the other series This fact, along with the distinctly higher incidence of over all successful results, provides good evidence of its clinical value and efficacy

Dacron Tube and Bifurcation Arterial Prostheses Produced to Specification· II Continued Clinical Use and Addition of Microcrimping O C Julian, R A Deterling Jr W S Dye, S Bhonslay, W J Grove, M L Belio and H Javid[3] used flat taffeta Dacron bifurcations in resectional therapy of 85 patients with abdominal aortic aneurysms 12 of whom had ruptured aneurysms and 73, elective resections Of those with ruptured aneurysms, 6 died, and of those who had elective resection, 7 died In addition 1 patient died a year after operation of coronary occlusion, and 1 died 3 months postoperatively of rupture into the jejunum of a pulsating hematoma at the proximal anastomosis

Dacron fabric will set in pleats or folds when compressed into a desired shape and set on a heated mandril at temperatures below the melting point of Dacron When cooled, the tube has a *springlike* adherence to its new shape After heating and cooling, the finished tube is easily slipped off the

(3) A M A Arch Surg 78 260 270 February 1959

mandril It can be bent over acute angles of up to 120 degrees without kinking The microcrimped tube should be implanted under sufficient tension to restore about 75% of the original length For end-to-side anastomoses of a bypass, the beveled cut end may be lightly fused with a cautery at a temperature of just below visible heat, resulting in an edge that shows no tendency to fray Heat fusion is not necessary and scissors may be used to bevel or cut the crimped graft to proper length

After initial animal trials with the crimped graft, 75 bypasses were accomplished in 74 patients, most often from the femoral artery level to the popliteal In 54 such restorative operations, an incision below the knee was used in 33 and one just above the knee in 21 In 1 patient, a graft was placed in the superficial femoral artery to replace a homo graft that had become aneurysmal An entirely satisfactory blood flow has been maintained for 9 months in 68 of these 75 prostheses Nine grafts placed as bypasses from the abdominal aorta to the popliteal artery or from the com mon or external iliac to the popliteal artery were successful, as were 10 bypasses placed between the aorta and the com mon or superficial femoral artery Two grafts to bypass occlusions of the carotid or subclavian arteries, one between the aortic arch and internal carotid, have maintained completely satisfactory blood flow for 3 and 2 months, respectively

Previous criteria for selection of patients have largely been abandoned in favor of direct surgical exploration of the popliteal artery bifurcation as an initial step in patients scheduled for supracondylar amputation In 2 patients in this series, a patent popliteal bifurcation was found and a bypass was placed, with restoration of circulation and avoidance of limb loss

With the new Dacron tube construction, length and flexibility are adequate to permit the patient hip and knee flexion Consequently there is a choice of proximal anastomosis sites When inequality of the femoral pulses and a bruit audible over the femoral artery are present, and in those patients with no femoral pulse, the proximal anastomosis is made within the abdomen at whatever point is necessary to gain an entirely unobstructed source of pulsatile flow

On Factors Underlying Intravascular Clotting From results of simple experiments, such as varying certain factors in determining clotting times, estimating prothrombin consumption before and after separating the serum from the clot and injecting thrombin intravenously, Armand J Quick[4] (Marquette Univ) obtained evidence which strongly suggests that extensive intravascular clotting does not originate in the blood itself and that hypercoagulability is rarely if ever a predisposing factor to thrombosis

It is postulated that venous thrombosis is initiated by injury of the vessel wall that causes a localized liberation of tissue thromboplastin to produce a clot attached to the area of injury When this clot retracts, a serum rich in nascent thrombin is expressed With good circulation, the serum is rapidly diluted and swept into the blood stream If blood flow is sluggish the serum causes formation of a secondary clot attached to the primary thrombus Repetition of this process accounts for growth of the thrombus in the direction of the blood stream The secondary clot in turn undergoes retraction whereupon a third attached thrombus is produced By continuance of this process a thrombus beginning in the lower part of the calf may gain such length as to extend into the iliac vein When the area of injury or irritation of the vessel wall is small a thrombus may form without producing any symptoms or signs until it breaks loose and produces a pulmonary embolus (phlebothrombosis) If the area of irritation or inflammation of the vessel wall is large or involves the entire lumen the vein may be entirely occluded with swelling, pain and other inflammatory signs (thrombophlebitis)

Growth of the thrombus according to Quick s hypothesis is dependent on clot retraction (table) The more rapid and complete the retraction, the more favorable the condition for formation and growth of the thrombus In the test tube clot retraction is directly influenced by the number of intact platelets and concentration of thrombin and in

(4) S Clin North America 38 1031 1043 Jul 1958

versely, by concentration of fibrinogen and cell volume It seems justifiable to assume that these factors are operative in vivo and have an important bearing on the thromboembolic state Correction of anemia is indicated, since clot retraction decreases with greater cell volume Anticoagulants, such as heparin and Dicumarol®, slow clot retraction by decreasing available thrombin These agents further lower

MAJOR PHASES OF COAGULATION MECHANISM

	PARTICIPATING FACTORS SOURCE AND AGENT*	CATALYST	INHIBITOR	PRODUCT FORMED	DURATION OF REACTION†
Phase 1 Production of plasma thromboplastin	Platelets piastrin Plasma thromboplastinogen A thromboplastinogen B Others less clearly defined	Thrombin	Fibrin surface	Thromboplastin	Several minutes
Phase 2 Formation of thrombin	From Phase 1 } thromboplastin Injured tissues } Plasma prothrombin stable factor labile factor calcium			Thrombin	Several seconds
Phase 3 Clotting of fibrinogen	From Phase 2 thrombin Plasma fibrinogen		Heparin*	Fibrin	Several seconds
Phase 4 Clot retraction	From Phase 3 fibrin Platelets intact platelets	Thrombin*	Increased cell volume Increased fibrinogen	Retracted clot	Relatively long

*Synonyms Piastrin = Proposed name for clotting factor in platelets
Thromboplastinogen A = Antihemophilic globulin (AHG) factor VIII
Thromboplastinogen B = Plasma thromboplastin component (PTC), Christmas factor factor IX
Stable factor = Serum prothombin conversion accelerator (SPCA) proconvertin factor VII
Labile factor = Ac globulin proaccelerin factor V
†Duration estimated from test tube experiments

the thrombin concentration of the serum from the retracted clot, thereby decreasing the possibility of continued growth of the thrombus

The practice today is to give a sufficient dose of Dicumarol® to increase prothrombin time to the maximum consistent with safety from hemorrhage Obviously, therapy remains empiric, and the level of prothrombin activity which would with certainty protect against thromboembolism has not been determined accurately and satisfactorily Considerable progress could be made by adoption of a standard technic for determining prothrombin activity

Clinical Experience with Anticoagulant Anisindione (Miradon®). H A Paul, P M Arscott, J L Koppel and

J H Olwin[5] (Univ of Illinois) administered anisindione to 105 patients with and without thromboembolic disease The drug was a safe, effective prothrombin depressant therapeutic levels being attained on the 2d, 3d or 4th day in most patients The shortest induction period was 48 hours The dosage schedule of 500 mg on the 1st day, 300 on the 2d and 200 on the 3d, followed by daily dosage as indicated by prothrombin levels appeared to be the most satisfactory The dose required to maintain patients at control levels ranged from 50 to 150 mg/day, given as a single dose

After withdrawal of the drug, prothrombin levels rose to above 30% of normal in 36 hours in most instances 60% prothrombin levels were observed 60 hours after the last dose of the drug was given Return to normal prothrombin levels was accelerated by intravenous administration of fat soluble vitamin K substances

Besides its effect on prothrombin, anisindione was observed to depress the level of plasma Ac-globulin The TAMe (p-toluenesulfonyl l arginine methyl ester) method for prothrombin assay was well suited for controlling the administration of anisindione

Liver function tests and bone marrow studies showed no toxicity in patients receiving the drug for up to 1 year Bleeding, never serious, was observed in 6 patients Chromaturia was observed as a side effect during the early phases of therapy This was related to the amount of drug administered rather than to low prothrombin level Several simple observations can be carried out by the patient to distinguish chromaturia from hematuria

Thrombolysis with Fibrinolysin (Plasmin) New Therapeutic Approach to Thromboembolism Kenneth M Moser[6] (Georgetown Univ) studied the effects of intravenously given fibrinolysin in 52 patients with various forms of thromboembolic disease The resulting increase in fibrinolytic activity of the patient s plasma was demonstrated by laboratory determinations of the rate of dissolution of a standard fibrinogen thrombin clot When the dosages were 40 000 50 000 fibrinolytic units 92% of the recipients manifested an enhanced plasma fibrinolytic activity at some time

(5) Surg Gynec & Obst 108 605 615 May 1959
(6) J A M A 167 1695 1704 Aug 2 1958

after the infusion No hemorrhagic phenomena were encountered in any patient, including 29 who were simultaneously receiving anticoagulant drugs Disturbances of blood-coagulating factors were minimal

Although individual patients showed moderate variation in rapidity and degree of response, the over-all experience with fibrinolysin infusion in deep venous thrombophlebitis included (1) loss of heat, tenderness and muscle turgidity and significant decrease in leg size within 24 hours, (2) return of the involved area to its prephlebitic state within 72 hours after infusion, and (3) no recurrence of signs of phlebitis when ambulation was allowed

Eight patients with pulmonary embolism in whom no definite thrombotic source could be incriminated received fibrinolysin infusion within 72 hours of the embolic event In 4 patients, fibrinolysin therapy exerted some beneficial effect, as suggested by rapid resolution of ECG abnormalities, rapid relief of chest discomfort, tachypnea and other symptoms and signs induced by embolization, and interruption of a course of recurrent embolization which had not responded to anticoagulant therapy

Animal studies suggest that rethrombosis after successful clot dissolution may occur if fibrinolysin is used alone but can be prevented if heparin is used concurrently Therefore, it appears that anticoagulant drugs should be used to avoid rethrombosis in all patients unless circumstances clearly indicate that the factors which led to thrombosis have subsided satisfactorily

Management of Acute Venous Thromboembolism is described by William G Anlyan, George D DeLaughter Jr, Jacob I Fabrikant, John W Sullenberger and William T Weaver[7] (Duke Univ) Venous thromboembolism remains one of the major hazards after surgery, trauma or parturition The object of its treatment is twofold to avoid fatal pulmonary embolism and minimize postphlebitic sequelae A hypercoagulability state appears to be the basic etiologic factor, this may be aggravated by intimal damage and venous stasis Symptomatology may vary from none to a combination of pain swelling, venous distention and pulmonary embolism In the syndrome of arterial spasm complicating

(7) J A M A 168 725 729 Oct 11 1958

deep venous thrombosis (phlegmasia cerulea dolens) salient features differentiate it from primary acute arterial occlusion.

Two laboratory tests that aid in diagnosis of venous thrombosis were developed for use in patients with borderline symptomatology: (1) isotope outflow study for detecting venous stasis, and (2) detection of the serotonin breakdown product (5-hydroxyindole-acetic acid) in the urine in increased amounts in intravascular thrombosis. Anticoagulant therapy is the treatment of choice. In pulmonary embolism, an 8-day course of heparin followed by several weeks of coumarin therapy is advised to obviate recurrent embolism. Vena cava ligation is indicated in coexistent bleeding or when embolism is recurrent despite anticoagulant therapy.

Of the authors' 500 patients, 170 had primary acute deep venous thrombosis treated with anticoagulants and were followed for 3 or more years. Of the 170 patients, 150 were evaluated for postphlebitic sequelae after intensive treatment with anticoagulants during their acute phase. Results were: no sequelae, leading normal life, 55%, wearing elastic supports full or part time, 19%, slight to moderate edema, 12.6%, dermatitis, 13.5%, incompetent superficial veins, 8.6%, and ulceration, 2.3%. In some patients, postphlebitic sequelae were noted in the opposite normal limb that had appeared to be free from deep venous thrombosis at time of initial treatment. Thus in unilateral disease the uninvolved limb should be managed with equal concern. Femoral vein ligations have no place in the therapeutic armamentarium for venous thromboembolism.

Management of Venous Thrombosis and Pulmonary Embolism in 114 patients, including 34 with superficial saphenous thrombophlebitis, is described by Wiley F. Barker[8] (Univ. of California, Los Angeles). Of 84 with deep venous thrombosis, 16 also had superficial saphenous thrombophlebitis; 38 had pulmonary embolism during some part of their course. Venous thrombosis recurred in 5 of 14 patients who received no anticoagulant therapy, in 6 of 42 who received heparin and in 11 of 24 taking Dicumarol®. In 6, 1 of whom received heparin, thrombophlebitis recurred while on adequate anticoagulant therapy in the hospital. The other re-

(8) Surgery 45: 198-203, February, 1959.

currences appeared 2 days to 6 months after cessation of treatment or previous thrombophlebitis

Ten patients who had pulmonary embolism and were not treated by anticoagulants died Of these, 1 had thrombocytopenic purpura and died of recurrent embolism after ligation of both superficial femoral veins Of 28 patients with pulmonary embolus treated with anticoagulants, only 6 had no recurrence during or after therapy

These results indicate a serious failure rate in recurrent venous thrombosis or pulmonary embolism treated by anticoagulants Heparin was more effective than Dicumarol® in relieving symptoms of venous thrombosis, but heparin treatment was associated with a number of fatal pulmonary emboli during what appeared to be adequate therapy

For surgical patients with a complicated postoperative course, medical patients with protracted illness that might serve as a continuing causative agent or those in whom thromboembolism develops spontaneously, venous interruption is probably warranted Ligation should be performed at as high a level as is compatible with reasonable surgical risk Venous interruption should be immediately supplemented with postoperative heparin Little worry need be given to the risk of increasing the patient's tendency to postphlebitic edema Venous thrombosis associated with any situation that precludes anticoagulant therapy carries a serious mortality risk and vein ligation at a high level should be offered, even though the protection afforded is not as satisfactory

Theory and Practice in Acute Venous Thrombosis Reappraisal, based on 5 year experience, is presented by Stanford Wessler and Daniel Deykin[9] (Harvard Med School) The basic hypothesis is that persons with clinically recognized intravascular clotting have a state of hypercoagulability, as yet not demonstrable, that predisposes them to thrombosis When the balance between clot formation and clot lysis is altered a thrombus can be initiated and potentiated by a degree of stasis that would not by itself result in clot formation Hypercoagulability and vascular stasis may be systemic or local transient, prolonged or recurrent

Specific treatment of acute phlebitis is reduced at present to neutralization of hypercoagulability by anticoagulant

(9) Circulation 18 1190 1214 December 1958

drugs and decrease in vascular stasis by reduction of immobilization and use of elastic supports Vein ligation and other measures become ancillary therapeutic tools

For initial episodes of acute superficial or deep phlebitis watchful waiting for 12-24 hours is usually justified Bed rest is used without immobilization and with elevation of the involved extremities if edema is present If phlebitis appears to progress, anticoagulant therapy is begun if no hemorrhagic tendency exists If no progression or regression is noted gradual increase in activity is immediately begun and is continued, if symptoms do not recur With ambulation, a properly fitted cotton or nylon elastic lower leg stocking is prescribed, even if phlebitis originally occurred in the thigh, provided there is no peripheral arterial insufficiency Use of elastic support is continued for 4 weeks during hours when the patient is ambulatory

In certain instances of spontaneous massive iliofemoral phlebitis or in patients with acute myocardial infarction or congestive heart failure or after operations requiring immobilization, it may be reasonable to treat immediately with anticoagulants because of the presumed serious danger of embolization Treatment with heparin is started and if only the acute episode of phlebitis is to be treated with anticoagulants this is accomplished with heparin alone, intravenously every 4 hours through an indwelling plastic catheter inserted into a superficial forearm vein Dosage is 25 100 mg at each injection, which is adjusted with the aid of clotting times After the dose is established, clotting times are determined once daily Heparin is continued for 8 10 days

In patients with recurrent phlebitis, heparin therapy is started initially and continued until symptoms of discomfort appear Dicumarol® is added and the two drugs are given concurrently for a week Heparin is then stopped, and the patient is discharged with Dicumarol®, controlled by weekly prothrombin determinations Prolonged use of Dicumarol® is limited to 4 6 months unless acute phlebitis recurs at that time If phlebitis recurs after discontinuance of the drug, anticoagulant therapy is resumed, this time for about 12 months

Heparin dosage is decreased stepwise by 5 mg every 4 hours and Dicumarol® (in patients who have received it for

several months) is decreased in such manner that prothrombic activity does not return to normal for 2-3 weeks

The patient who is believed to have sustained pulmonary embolus, with or without peripheral phlebitis, is treated as a patient with recurrent venous thrombosis

Vein ligation is ordinarily not used prophylactically, but is invoked only after venous thrombosis has occurred Its use is restricted to patients in whom the potential vein source may be septic, in whom anticoagulants cannot be used with safety and in whom the drugs have been ineffective in preventing clots Embolectomy and autonomic blockade for acute venous thrombosis or pulmonary artery obstruction have not yielded convincing results Antibiotics have no place in routine treatment of venous thrombosis and should be restricted to phlebitis complicated by infection

Most patients with idiopathic phlebitis do not have cancer Among those who have phlebitis and cancer, some evidence of malignancy is common by the time phlebitis appears No "cures" of carcinoma detected after onset of phlebitis have been observed

► [The preceding 3 articles, providing thoughtful analyses of the authors' respective experiences and representing somewhat divergent points of view concerning therapy, reflect well the continued lack of unanimity which has prevailed for well over a half century among students of this problem As emphasized previously, there are undoubtedly a number of factors which have contributed to this continued state of confusion and diversity of opinion Most important among these are lack of precise knowledge about the etiology and pathogenesis of the disease and the absence of an accurate test or method of diagnosis It seems reasonable to assume that until these difficulties are satisfactorily resolved reports on the therapeutic management of this problem will continue to be characterized by discrepant and often conflicting studies —Ed]

Vein Stripping for Saphenous Vein Thrombophlebitis. According to James M Sullivan[1] (Marquette Univ), phlebitis of the saphenous system must be differentiated from deep phlebitis and considered as a separate entity, since treatment of the two diseases is diametrically opposed, and prognosis is entirely different The etiology of both diseases shows some similarity, in that venous blood stasis seems to be a causal factor in each In some cases varicose veins are so minimal as not to be recognized until an attack of thrombophlebitis occurs

In acute saphenous phlebitis, a painful red swelling ap-

(1) S Clin North America 38 1071 1079 August 1958

pears along the course of one of the varices or of the saphenous vein itself There is no appreciable swelling of the leg edema of the ankle or calf tenderness Generalized signs of infection are minimal The history may also reveal the attack to be a recurrence of similar episodes which responded to hot packs and elevation or to ambulatory treatment with elastic bandages or stockings Clots removed from areas of saphenous phlebitis on innumerable occasions have been found to be sterile

Mild phlebitis of the saphenous system can be managed successfully with elastic stockings or elastic bandages while the patient remains ambulatory However, most patients require vein stripping and high ligation for relief This operation cares for the underlying varicose veins and decreases morbidity Complications are no greater than those of vein stripping for uncomplicated varices

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ABDOMEN—GENERAL

Serum Lactic Dehydrogenase in Diagnosis of Acute Surgical Abdomen The enzymatic activities of blood serum have been useful in the diagnosis of a number of surgical and nonsurgical diseases The activities in serum of various intracellular enzymes such as glutamic oxaloacetic, transaminase have been shown to rise after surgery, fractures hepatitis and myocardial infarction The serum lactic dehydrogenase (LDH) level has been observed to rise after myocardial infarction

Carl Calman Falls B Hershey Jerome O Skaggs and Andrew Spencer[2] tested the value of serum LDH activity in preoperative diagnosis of necrotic intestine secondary to volvulus or mesenteric vascular occlusion The enzyme LDH was chosen because of its relatively high concentration in intestine and intestinal mucosa

Elevation of LDH levels of over 3 times normal was noted in 8 of 11 patients with intestinal infarction Mechanical small bowel obstruction without necrosis intestinal distention from other causes and of varying degree, generalized or localized peritonitis and surgical operations of large mag

(2) Surgery 44 43 52 July 1958

nitude did not cause such striking rises Serum LDH activity appears to be more specific for intestinal necrosis than other laboratory criteria, however, it rises after infarction of other tissues, including myocardium, lung and kidney, and this must be considered in differential diagnosis

The presumed origin of increased serum LDH activity is from intracellular enzymes released after cellular damage Other possibilities, such as activation or release of inhibition of serum LDH, have been proposed Whatever the mechanism, the association with dead tissue is apparently constant The only exceptions to this are the high levels associated with widespread malignant disease and hepatitis due to Thorazine® Here necrosis cannot be excluded but is difficult to estimate The data indicate that false positive examinations should not be troublesome or confusing If the serum LDH level is over 300 in a patient with intestinal obstruction, intestinal necrosis is almost certain unless some other tissue is coincidentally infarcted or damaged A high serum LDH level is a more specific index of infarction and may be more sensitive than fever or leukocytosis

Diagnostic Paracentesis is a satisfactory aid in diagnosis of otherwise difficult problems, and in many cases it has definitely established the subsequent correct treatment in the acute, as well as in the pseudoacute, surgical abdomen, according to J H Strickler, Paul D Erwin and Carl O Rice[3] Their technic (Fig 92), used in over 100 cases is as follows

TECHNIC—Sterile preparation and draping is carried out in the patient s bed Procaine infiltration of the skin fascia and peritoneum is done 1 in lateral to the midline and below the umbilicus A 2 mm incision is made in the skin to keep the needle from binding A 4 in , 14-gauge, styleted needle is used The resistance of the posterior and anterior rectus sheathes are identified as the needle passes through The styleted needle prevents plugging by fat or other tissues and picking up of blood as the needle passes through the abdominal wall After the needle has entered the peritoneal cavity, 12 18 cm polyethylene tubing is threaded through the needle and inserted After 1 or 2 minutes the needle is removed, and the polyethylene tube is left in Air or saline 2 3 cc , is injected to determine the absence of a kink in the tube Gentle aspiration with a syringe is used as the polyethylene tube is slowly withdrawn The patient s position may be changed during this procedure

A small spurt of blood as the tube is pulled out through

(3) A M A Arch Surg 77 859 863 December 1958

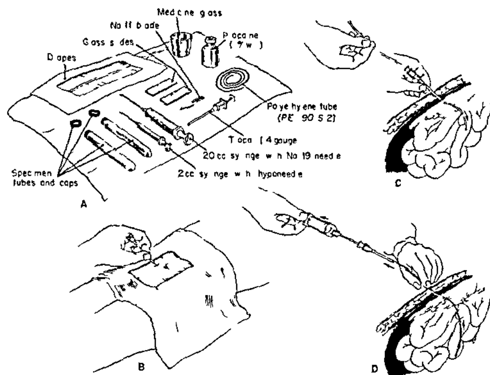


Fig 9?—Diagnostic paracentesis *A* setup of equipment *B* site of tap *C* insertion of polyethylene tube *D* withdrawal of diagnostic fluid (Courtesy of Strickler J H *et al* A M A Arch Surg 77 859 863 December 1958)

the last 2 in may come from perforation of the abdominal wall Bleeding from organs within the peritoneal cavity usually appears early in the aspiration Clotted blood from the abdominal wall will appear near the end of withdrawal of the tube Perforation is more likely to occur where bowel is adherent, hence any scarred area should be avoided Bowel was perforated in 2 patients, but no complications or sequelae developed in either

► [Diagnostic paracentesis may be a valuable procedure however the use of the polyethylene tube described above is not necessary A positive tap is highly significant, but negative taps do not exclude intra abdominal disease —Ed]

Hemoperitoneum Record of 129 Consecutive Patients with Notes on Some Unusual Cases is presented by H Ellis, P W W Griffiths and A MacIntyre[4] (Radcliffe Infirm Oxford, England) In all 129 patients extensive collection of frank blood was found at operation or post mortem Bleeding was of gynecologic origin (ruptured ectopic pregnancies or ruptured follicular cysts) in 87 (68%) and in 30 (23%),

(4) Brit J Surg 45 606 610 May 1958

followed trauma to the spleen or liver or both Four others had ruptured aortic aneurysm leaking into the peritoneal cavity and 2 had severe postoperative hemorrhages In 6 patients, the origin of hemoperitoneum was unusual spontaneous rupture of primary carcinoma of the liver, hematemesis from gastric ulcer with fatal rupture of a distended stomach, hemorrhage from retroperitoneal varices associated with cirrhotic liver in 1 each and "spontaneous" intraperitoneal hemorrhage in 3

It was evident in nearly all the patients that an intra abdominal disaster had occurred except in 8 dying after splenic and/or hepatic trauma, who had overwhelming and rapidly fatal head injuries Abdominal lesions were found at autopsy, often accompanied by multiple injuries elsewhere Common gynecologic emergencies and traumatic hemorrhages uncomplicated by head injuries were correctly diagnosed preoperatively in 87%

The single fatality among those in whom bleeding was of gynecologic origin was a girl, aged 17, with known thrombocytopenic purpura who had splenectomy 5 years earlier, but the bleeding tendency had persisted Autopsy revealed a massive hemoperitoneum due to hemorrhage from a ruptured follicular cyst Of the 22 patients with traumatic hemoperitoneum uncomplicated by head injury, only 1 died All 4 with intraperitoneal rupture of aortic aneurysms were undiagnosed and all died Of the 2 with postoperative hemorrhage, 1 died In the 6 patients in whom the origin of hemoperitoneum was unusual, incorrect diagnosis was made before surgery or autopsy and only 1 survived

Arteriosclerosis and congenital vascular defects probably explain most cases of abdominal apoplexy that are not due to some more obvious cause In patients with no arteriosclerosis, diagnosis of some congenital vascular defect is often made on negative grounds, as was true in 2 patients In another patient hypertension was the apparent cause, although arteriosclerosis was not severe In this patient discovery of the hemorrhage site was fortuitous on microscopic examination of vessels in relation to the pancreas The authors suggest that failure to find the bleeding point in some patients with abdominal apoplexy in this series and in reported cases was not because some local focus did not exist

but because pathologic investigation was less fortunate

Subphrenic Abscess J E Strode[5] (Straub Clinic, Honolulu) reviewed 41 cases Drainage of a subphrenic abscess requires familiarity with certain anatomic landmarks about the liver The falciform ligament (Fig 93) extends from the umbilicus upward over the anterior superior surface of the

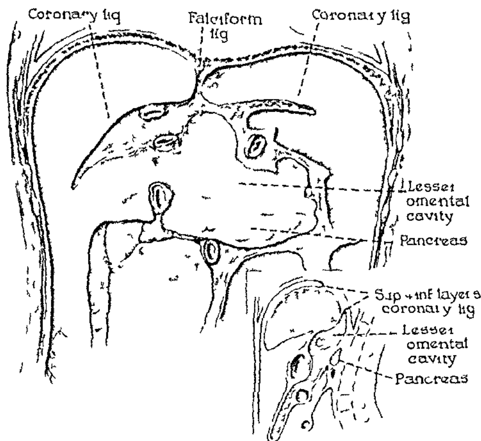


Fig 93 —Anatomy in subphrenic area with which one should be familiar in dealing with subphrenic abscess (Courtesy of Strode J E Surgery 44 1054 1061 December 1958)

liver and divides it into the right and left lobes Posterior superiorly, leaves of the falciform ligament separate and turn right and left to form the coronary ligaments, continuation of which forms the right and left triangular or lateral ligaments of the liver These reflections of the peritoneum have led to the generally accepted division of spaces about the liver as *(1)* intraperitoneal—right anterior subphrenic area proper, posterior subhepatic area left anterior subphre-

(5) Surgery 44 1054 1061 December 1958

the area proper and posterior lesser omental cavity and extraperitoneal—right and left

Though subphrenic abscess occurs less often than be use of antibiotics, it is still a significant complication of gery Since it usually occurs in patients debilitated by original illness, morbidity and mortality continue to b rious Early recognition and adequate drainage of abscess cavity is of utmost importance if a satisfactor covery is to be expected Masking effects of antibiotics to obscure symptoms and signs previously relied on a dicative of this complication Awareness of the possit of subphrenic abscess following conditions in which complication arises, such as ruptured appendix, duoden gastric ulcer or acute infection of the gallbladder, is a factor in early recognition The possibility of an absce the pancreas (usually as a sequel to acute pancreat rupturing into the lesser omental cavity should also b membered Enough such abscesses occur after gastric r tion where the viscus has not ruptured and after cholecy tomy without infection to make one suspicious of possibility when the patient fails to recover as expecte patient who fails to recuperate satisfactorily after uppe dominal surgery and who has fever, leukocytosis and derness along the subcostal margin should be regarde having a subphrenic abscess until this is disproved Su complication may exist without as many suggestive ings Under such circumstances the finding of dullness in lower thoracic cage, with rales, bronchial breathing or sent breath sounds, is certainly more indicative of tro below the diaphragm than of a primary lesion in the l If, with these signs, x-rays reveal a high fixed diaphra one may be assured that subphrenic abscess is present surgical drainage is indicated

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THE ADRENAL GLANDS

symptoms, except as the result of pressure Adrenal insufficiency associated with bilateral cystic lesions of the adrenal gland has been reported in children The cysts vary in size from a few millimeters to 30 cm in diameter False cysts that arise from central hemorrhage or necrosis of normal or abnormal glandular tissue are the commonest and largest Cysts produced by dilatation or proliferation of the vascular or lymphatic channels usually are small and are seen only at autopsy Many of the pseudocysts have focal calcification that has followed necrosis of lipid-containing adrenal cortex

Frank V Hodges and Frank R Ellis[6] (Wayne County Gen'l Hosp, Eloise, Mich) observed these lesions in 2 patients at surgery and in 2 at autopsy In the former, hemorrhage or infarction in otherwise normal adrenal glands could account for the changes One of the patients who came to autopsy presented cystic lymphangiectasis of the adrenal gland which possibly arose from lymphatics in the medulla, since lymph channels in the human adrenal gland are found only in the capsule and medulla At the other autopsy, a multiocular cyst was found within a hyperplastic adrenal gland containing focal nodular hyperplasia The focal calcification in the cyst wall suggested previous necrosis of lipid containing tissue The thick walls of the cyst probably prevented the imbibition of fluid by the contents of the cyst Cystic degeneration of a cortical adenoma is rare, but if an adenoma should become large enough, it is conceivable that it could become cystic Cystic degeneration of medullary tumors is fairly common

Eighteen Pheochromocytomas: Clinical Aspects and Surgical Results E Dahl Iversen[7] (Copenhagen) treated 8 men, 8 women and 2 boys, aged 10 and 15 respectively, for pheochromocytomas Duration of the disease until surgery was 2 months to 14 years in 17 patients and 30 years in 1 Paroxysmal hypertension was present in 12 patients During attacks the blood pressures ranged between 230 300 mm Hg systolic and 135 140 diastolic Sustained hypertension was present in 5 blood pressure in this group, systolic/diastolic, was 160/125 minimum and 265/210 maximum

In 11 patients, the retinas were normal, but hypertensive

(6) A M A Arch Path 66 53 58 July 1958
(7) Acta chir scandinav 116 118 131 1958 59

retinopathy varying from grades II to IV was found in 7, apparently independent of the duration of the disease and the type of hypertension The amount of total adrenaline in the urine varied between 206 and 3,800 μg/24 hours in those with paroxysmal hypertension and between 800 and 3,100 μg/24 hours in those with permanent hypertension

The number of eosinophils was determined in 10 patients, 7 of whom had paroxysmal hypertension, the eosinophil count was normal in 6 and in 1, it was under 50 on four occasions During an attack, the count was 0 The BMR was increased, between 125 and 190%, in 7 of 18 patients The blood sugar was elevated, between 112 and 224 mg/100 ml in 10 patients, mostly in connection with attacks, but in a few also when they had no attack Glycosuria, found in 2 patients, occurred periodically

The histamine provocative test, tried on 7 patients, was positive in 5 The Regitine® test, used in 5 patients during an attack, was positive in all Intravenous urography, performed in 18 patients, was normal in 17 Retroperitoneal, precoccygeal pneumography combined with tomography, used in 10 patients, showed the tumor distinctly in 9 One patient had bilateral tumors

The pheochromocytoma, which was removed mostly by enucleation in 15 patients, was intra-adrenal in 14 and ectopic in 1 There were no deaths The other 3 patients were in such poor condition that they died before localization of the tumor or before the tumor could be removed Signs of renal failure resembling tubular necrosis (lower nephron nephrosis) developed in 3 patients After removal of the tumor and subsequent stabilization of blood pressure, 11 of 14 patients had normal blood pressure and 3 had blood pressures from 150/95 to 160/100

After an average follow up of 4 3 years, the blood pressure was normal in 13 patients, whereas in 2, the pressures were 180/130 and 230/150 No hypertensive attacks were noted after surgery

Surgical Treatment of Cushing's Syndrome Frank Glenn, Richard C Karl and Melvin Horwith[8] (New York Hosp-Cornell Med Center) describe results in 32 patients (30 females) treated over the past 24 years The youngest patient

(8) Ann Surg 148 365 374 September 1958

was a boy, aged 9, and the oldest a woman, 52. The peak in- cidence age was in the 4th decade. Illness had lasted months to 18 years from onset of symptoms to time hospitalization.

The most common physical symptoms were muscul weakness and fatigue. A distinctive distribution of body f was also noted (Fig. 94). Occasionally, this resulted in a obese appearance without actual weight gain Most p



Fig 94—Truncal obesity with tapered extremities and purple striae (Courte of Glenn, F, et al Ann Surg 148 365 374, September, 1958)

tients had moon facies and hirsutism. Scalp hair pulled o easily. Of 28 women with normal menses before disease or set, amenorrhea or menstrual irregularity developed in 2 Psychic problems varied in severity. The disease was als diagnosed by laboratory determinations of 17-hydroxycor ticoid levels in the serum and urine These values were ele vated in 19 of 22 patients on whom analyses were done Uri nary 17-ketosteroids were increased in 15 of 28 patient tested.

The primary pathologic finding in 25 patients was adre nal hypertrophy Since there is no satisfactory medical ther apy for Cushing's syndrome, surgical removal of the hyper functioning adrenal cortical tissue provides permanen remission. The authors favor a lateral incision, with resec tion of the 12th rib The entire procedure is retroperitonea

Except in the presence of adenoma or of previous successful unilateral adrenalectomy, total bilateral adrenalectomy is performed in two separate procedures.

Among the 30 patients undergoing operation, 20 had total adrenalectomy, 9 unilateral adrenal resection and 1 adrenal biopsy. There was no operative mortality. The other 2 patients, who were the first of the series, received no surgical treatment and died of the disease.

At the time of the first procedure, no substitution therapy was given preoperatively. When adenoma was found, 100 mg. hydrocortisone was given intravenously in an infusion of 5% glucose and distilled water. At the end of surgery 100 mg. cortisone was given intramuscularly and repeated 8 hours later. Thereafter, cortisone was tapered off during several days. Occasionally, ACTH was given to stimulate the other adrenal gland. At the time of the second adrenalectomy, 100 mg. cortisone was given intramuscularly the night before surgery and again 2 hours before anesthesia. Unless 100 mg. hydrocortisone was given during the procedure, a further 100 mg. cortisone was administered immediately after operation, with 5 mg. desoxycorticosterone acetate. This was repeated 8 hours later. Over the next several days cortisone was gradually decreased to a level of 12.5 mg. 2 or 3 times daily. The daily dose of desoxycorticosterone acetate was reduced to 1.5 mg. and thereafter 0.125 or 0.25 mg. α fluorohydrocortisone was given orally each day.

Patients who underwent bilateral adrenalectomy were instructed to report onset of any illness immediately. Appropriate increases in cortisone therapy were then instituted. Since operation, 2 patients have had normal pregnancies, and others have undergone major surgery without difficulties.

THE LIVER AND SPLEEN

Primary Sclerosing Cholangitis: Review and Report of Six Cases are presented by Seymour I. Schwartz and W. Andrew Dale[9] (Univ. of Rochester). This disease is an uncommon diffuse inflammation of the extrahepatic bile duct even-

(9) A.M.A. Arch. Surg. 77: 439-451, September 1958.

tuating in sufficiently widespread occlusion of these ducts to cause jaundice and other manifestations of posthepatic biliary obstruction The condition has also been referred to as obliterative cholangitis and stenosing cholangitis, but since the obliteration and stenosis of the ducts are the result of a thickened duct wall, sclerosing cholangitis more accurately connotes the disease process

The cause of the disease is unknown Although low grade bacterial infection has been considered, absence of the usual systemic manifestations of infection and failure to identify an organism rule against bacterial origin

The pathologic process appears grossly as a diffuse thickening of the walls of the extrahepatic biliary tract with a *concomitant encroachment on the lumen, resulting in* marked luminal narrowing The duct system may be completely involved, or the hepatic ducts may be spared and the disease restricted to the entire length of the common duct The gallbladder is usually not involved

In some previously reported cases, microscopic analysis of the affected ducts showed the walls as much as eight times the normal thickness Areas of inflammation and fibrosis were observed in the submucosal and subserosal portions, with an edematous field between them The mucosa was intact throughout and showed no change Liver biopsies revealed bile stasis and periportal fibrosis

The outcome of sclerosing cholangitis is more favorable than has previously been considered Although the mortality in the cases reviewed was 43%, only 1 of the authors' 6 patients died, during a 1 9 year follow up The combination of surgical decompression of the biliary tract, corticoids, bile salts and antibiotics should result in a resolution of the disease and an appreciable improvement in the over-all mortality

► [As indicated by the author s review of the literature this is a difficult problem in which therapy has not been satisfactory Although the method of treatment has been used by the authors in only a few cases the more favorable results and well documented follow up observations warrant further consideration —Ed]

Intrahepatic Cholangiolitic Hepatitis Its Surgical Significance is evaluated by Barton McSwain, J Lynwood Herrington, Jr , William H Edwards, John L Sawyers and William R Cate Jr[1] (Vanderbilt Univ), in 11 patients In

(1) Ann Surg 147 805 811 June 1958

intrahepatic cholangiolitic hepatitis, moderate to profound jaundice occurs with few pathologic changes in the liver Of the 11 patients (8 men and 3 women, aged 31-74), 10 had no history of administration of any hepatotoxic drug, but 1 epileptic had received a diphenylhydantoin sodium derivative Symptoms had been present from 10 days to 16 months, 7 had symptoms for 1 month or less All had noted acholic stools, anorexia and weight loss, but nausea and vomiting occurred in only 2, 5 had fever and 5 upper abdominal pain Serum alkaline phosphatase and bilirubin were elevated in all Cholesterol was above 350 mg in 7 of the 10 patients tested Cephalin flocculation and thymol turbidity were normal, with one or two exceptions Preoperative diagnoses were common duct stone in 4, carcinoma of the head of the pancreas in 3 and carcinoma of the ampulla of Vater in 1 Three patients were correctly diagnosed

At operation, the liver was enlarged in all, the spleen and pancreas were normal The gallbladder was thin walled, of normal texture, contained little bile and in some was almost collapsed In 2 of 3 patients in whom cholecystectomy was done, small stones were found in the gallbladder In all, the common duct was small and slightly edematous In 10 in whom the common duct was opened, the bile was sparse, but normal in consistency and color and there were no common duct stones Although no actual obstruction was found, in 7 patients the ampulla was tight, dilated with difficulty and would not admit the largest Bake dilators Cultures from the common duct in 3 patients showed Escherichia coli in 2 In only 1 patient subjected to common duct exploration was drainage of the duct omitted

There were 2 hospital deaths In 2 other patients (1 without common duct exploration and the other without common duct drainage), jaundice persisted for 6 and 4 months after operation, but both are well after 29 and 12 months, respectively In 7 subjected to choledochostomy, subjective improvement occurred within a few days and the patients are well after follow up of 6 54 months, except for persistence of jaundice in 1

Why choledochostomy gave good results in these patients is not known Possibly it results in subsidence of surrounding edema or of bacterial or viral infection There may be a toxic agent in the bile and prevention of its recirculation

may possibly aid correction of pathologic changes in the liver

This type of hepatitis is probably often unrecognized and called viral hepatitis or cirrhosis If its existence is kept in mind when observing a patient with jaundice its true frequency may become known

Comparative Splenoportographic and Arteriographic Investigations in Study of Hepatic Pathology S Abeatici and F Morino[7] (Univ of Turin) examined patients with cirrhosis hydatid cyst and primary and metastatic hepatic tumors Portal circulation was studied by transparietal splenoportography and arterial circulation by selective arteriography through catheterization of the humeral artery These examinations permit determination of structural pathologic changes in the vascular system of avascular areas hemodynamic conditions of both circulatory systems especially by serial films and concentration or dilution of contrast medium which also provides an indication of decreased or increased circulatory flow

In hepatic cirrhosis severity of the stasis indicated by splenoportography is directly proportional to diminution of total conductivity and hence to the extent of vascular territory involved in the morbid process When stasis is severe large extrahepatic collateral vessels are also visualized especially in splenomegalic cirrhosis Selective arteriography does not furnish consistent findings in cirrhosis but varies in relation to type and stage Splenoportographic films and in vivo arteriography show certain parallel changes involving extra and intrahepatic vessels of the two afferent systems In early cirrhosis serial arteriograms show no circulatory slowing In advanced disease with considerable atrophy of the parenchyma reduction of the intrahepatic arterial network particularly at the periphery is conspicuous analogous to that observed in splenoportograms with respect to the portal bed Primary branches and even the trunk of the hepatic artery may be of diminished caliber In advanced cirrhosis serial angiograms show circulatory stasis with notable delay of venous return In cirrhosis with splenomegaly the trunk of the hepatic artery and its lobar branch present a relatively normal caliber whereas

(7) Minerva med 45 1952 197 Ma 16 19 8

branches of the second order are generally narrowed, with lengthening of single vessels, which, in pronounced hepatomegaly, follows a more divergent course than normal Saw tooth images of the intrahepatic arterial branches are less common in this form than in ordinary cirrhosis, but not exceptional Convolutions, however, are extremely rare

Characteristic morphologic changes of portal and arterial branches in cirrhosis are that they become tortuous, markedly undulated, saw-toothed and sometimes convoluted depending partly on compression, but representing essentially an adaptation of the vessels to reduced hepatic volume they are most marked in cirrhogenous hepatitis in a late phase

Comparative contrast studies of the hepatic vascular systems are not recommended routinely in hydatid cysts, but may be useful in doubtful cases in excluding tumor, in showing a deep cyst or multiple hydatid lesions or in precise localization in surgical cases

Splenoportography, in extrahepatic compression by a neoplasm besides revealing stenosis and precise localization of the site, extent and morphology, may permit evaluation of the stenotic tract or disposition of collateral circulation, furnishing an indication of hemodynamic repercussions of portal lesions When the intrahepatic venous network is not directly involved by neoplastic infiltration but are rare cases in which occlusion of the trunk is complete, but in general, opacification is normal though sometimes weak and slow In primary tumors, the changes are of two types those owing to periportal compression expressed by segmental dislocation of intrahepatic branches and those secondary to endoportal blastomatous infiltration, with signs of parietal rigidity and gross irregularity of vascular lumen and amputation of venous branches Some metastases produce little change, except for small avascular areas, usually not well defined, corresponding to individual foci

Findings of arteriographic films are analogous to those of portography Presence of small metastases in the parenchyma cannot be recognized with certainty, but a degree of vascularization may be indicated Extensive infiltration of the parenchyma, primary or metastatic, is easily recognized in angiograms by disruption of arterial structure character-

istic of neoplastic processes in general, i e , dislocation of primary or secondary arterial branches, disorganized distribution, with hypervascularized areas alternating with those poor or lacking in vessels, extreme irregularity of the course and caliber of visualized arteries, with clear signs of parietal rigidity and frequent amputation of branches Signs of compression by extrinsic tumors on extrahepatic arteries, because of greater resistance of the vascular walls, are less pronounced than in the portal trunk

The only contraindications to splenoportography and selective arteriography are severe renal or cardiac insufficiency The technic of the latter, however, is more delicate and complex and demands adequate instrumentation and preparation, with operation by a team

Natural History of Esophageal Varices· Study of 115 Cirrhotic Patients in Whom Varices Were Diagnosed Prior to Bleeding is reported by Lyle A Baker, Clifford Smith and Gerald Lieberman[3] (VA Hosp , Hines, Ill) Patients were followed 1-6 years (average 3 3) At the time the data were assembled, 74 were dead Bleeding had occurred in 33

Seventy-Four Deaths Divided According to Cause in Relation to Elapsed Time from Diagnosis of Varices*

Cause of Death	1st Yr	2nd Yr	3rd Yr	4th Yr	5th Yr	6th Yr	Total
All causes	38	21	8	5	1	1	74
	51 3%	28 3%	10 8%	6 7%	1 3%	1 3%	100%
Hemorrhage	11(7)	6(2)	2(2)	1	0	0	20
	55%	30%	10%	5%	0	0	100%
Hepatic failure	19	10	1	1	0	0	31
	61 2%	32 2%	03 2%	03 2%	0	0	100%
Other causes	8	5	5	3	1	1	23
	34 7%	21 7%	21 7%	13%	4 3%	4 3%	100%

*Figures in parentheses represent death from first hemorrhage

(28 6%) and 20 (17 3%) died of exsanguination, 11 (9 5%) during the first episode of bleeding Hepatic failure was the cause of death in 31 (26%) patients, and 23 died of unrelated causes In about 90% of those who died of liver disease, death occurred within 2 years after varices were diagnosed (table)

By the time all 115 patients are dead, between 10 and 15% will have died of the first hemorrhage This, then, is the ulti-

(3) Am J Med 26 228 237 February 1959

mate possible goal of achievement by routine prophylactic shunt surgery, against which must be balanced the mortality, failures and complications resulting from such operations Routine prophylactic decompression surgery does not appear to offer any definite advantage to the patient If further experience reveals (1) criteria for determining those patients most likely to bleed, (2) that over all surgical mortality can be lowered to about 5%, (3) that surgery prevents bleeding in nearly all patients over a period of years or (4) that there are serious remote untoward effects of hemorrhage on the course of the disease, then this conclusion may be unwarranted and routine prophylactic shunt surgery will be standard procedure

The authors believe there is a correlation between the severity of liver impairment and extent of varices, frequency and severity of bleeding and mortality from hemorrhage In most cases, hemorrhage does not appear to be an accident in the course of cirrhosis but is related to the presence of advanced liver damage

► [We agree that prophylactic shunts are not indicated —Ed]

Nutrition Requirements and Management in Patients with Cirrhosis of Liver Pre- and Postoperatively Based on the care of 300 patients with a portacaval shunt, Arthur H Blakemore and Arthur B Voorhees, Jr[4] (Presbyterian Hosp , New York) developed the following scheme of management Though absolute bed rest is not a necessity, bed rest with lavatory privileges serves a practical working arrangement in most patients, except in those in severe decompensation Duration of bed rest varies greatly from patient to patient and may last several months

Patek has recommended a diet containing 140 Gm protein, 365 Gm carbohydrate and 175 Gm fat, totaling about 3,500 calories a day For the most part, this remained the authors' standard If there is doubt that the patient can or will consume what is considered the minimal amount of protein and number of calories, forced formula feedings, consisting of 1 000 cc whole milk, 150 Gm Lanolac, 100 Gm Gevral®, 250 Gm dextrose, 2 eggs, 50 Gm strained beef and water up to 2 400 cc , are given through small, plastic nasogastric tubes To this the patient adds at will a diet of his choice that can be

(4) Ann Surg 147 875-880 June 1958

swallowed about the tube without discomfort The tube feeding method has one additional great advantage in instances in which severe limitation of sodium intake is desired, precise amounts can be given with an accuracy and control that is almost unobtainable in the standard hospital diet kitchen

Ammonia intoxication before portacaval shunt is relatively rare It is, on the whole, a transient phenomenon and is usually associated with acute depression of liver function from gastrointestinal hemorrhage and presence of a large amount of blood in the gastrointestinal tract Symptoms usually subside rapidly after neomycin and bacitracin orally and vigorous intestinal catharsis, despite a continued diet rich in proteins (120 150 Gm /day)

Vitamin B complex is added to the daily dietary intake, and 2 cc crude liver extract intramuscularly is given twice weekly when no specific vitamin deficiency is clinically evident Albumin administration can be of value in tiding a patient over a period of acute stress Whole blood transfusions are important in treating the otherwise uncontrolled anemias of cirrhosis

When a surgical procedure is contemplated for a patient with cirrhosis, the therapeutic program has to be put on a crash basis Despite this, the operative mortality rate dropped from 1 in 3 to 1 in 25, and the authors believe that this is primarily due to better pre- and postoperative management

► [These thoughtful observations on the pre and postoperative management of patients with cirrhosis of the liver with particular reference to their nutritional requirements are derived from extensive experience and well documented studies and deserve much emphasis —Ed]

Analysis of 42 Shunt Procedures for Portal Hypertension is presented by Cornelius E Sedgwick and H Alan Hume[5] (Lahey Clinic) In 28 patients, splenectomy and splenorenal anastomosis were carried out In 1 early case nephrectomy was necessary to effect anastomosis As experience with this procedure increases, however, it should rarely if ever, be necessary to sacrifice a kidney Eventual mortality (operative and late follow up) was 47%

End-to side portacaval shunts were carried out in 13 patients, with a final mortality of 46% One patient who had a

(5) A M A Arch Surg 78 359 363 March 1959

makeshift shunt between the inferior mesenteric vein and the left renal vein is alive, but clinical evidence suggests that the shunt is not functioning. In the splenorenal group, there were 4 (4.3%) deaths: 3 operative and 1 late death from liver failure. In the portacaval group, there were 3 (23%) deaths: 1 operative and 2 late deaths from liver failure. No operative deaths were caused by bleeding of varices in the splenorenal group, but 5 patients bled to death subsequently. In 1 patient with portacaval shunt, operative death resulted from bleeding varices that precipitated liver failure, but no late deaths were caused by bleeding in this group. The morbidity rate was 76% in the splenorenal and 50% in the portacaval group.

The main factors in the subsequent clinical course of these patients are the anatomic and physiologic status of the liver, and the technical adequacy of the shunt. There is a distinct relation between the adequacy of the shunt and subsequent bleeding of varices. Bleeding varices occurred in 12 (29%) of the 42 patients, with 6 (14%) deaths from bleeding. Postoperative bleeding of varices seldom occurs when the shunt is technically adequate (provided subphrenic abscess does not develop) and when the patients are maintained on a reasonable liver regimen subsequently.

Precise comparison of liver function among patients is impossible, as this factor is so readily influenced by the degree of patient cooperation in long-term liver therapy and the duration of time between surgery and study of liver function in relation to this cooperation. Postoperative neurologic symptoms occurred in only 1 patient in the entire series (after splenorenal shunt in a patient with biliary cirrhosis). Delayed neurologic signs appeared in 1 patient with a portacaval shunt but were readily controlled by reducing the protein intake.

Experience with Shunting Procedures for Portal Hypertension is reported by Philip F. Partington[6] (Western Reserve Univ.). Of 40 patients operated on during 8 years, splenorenal or portacaval shunts were performed on 27 and were considered impossible or were contraindicated in the others. Acute esophageal bleeding was treated initially with the Sengstaken-Blakemore tube, with recurrent bleeding, coma

(6) Surg. Gynec. & Obst. 107:37-46, July, 1958.

and death in over half the patients Three selected patients were then treated by transesophageal ligation of varices, with cessation of bleeding and no mortality

Criteria of suitable preparation for shunting included disappearance of jaundice and most, if not all, of the ascites, serum albumin level of 3 Gm/100 ml or over, bromsulfalein retention of not over 25%, hemoglobin value of 10 Gm or more, and no significant bleeding for a month preoperatively Percutaneous splenoportograms and portovenograms were useful in selection of the most suitable shunt Portacaval shunts were done 12 times—side to side in 4, end to side in 2 and with interposition of a segment of superficial femoral vein in 6 Splenorenal shunts, end-to side, were done 15 times

The 2 operative deaths gave an operative mortality of 7 4% Seven other patients died in 10 60 months, none of recurrent bleeding All but the last 3 patients operated on were followed 1-6 years Of the 4 patients who bled postoperatively, 2 had vein grafts, 1 a splenorenal shunt for schistosomiasis and 1 bled after splenorenal anastomosis until resection of a benign gastric ulcer

The true test of adequacy of the shunting procedure for portal hypertension is its efficiency in prevention of recurring hemorrhage from esophageal and gastric varices In this respect, portacaval anastomoses with use of an interposed vein graft appeared to be inferior No evidence was found of postoperative meat intoxication with either type of shunt There were only 2 Eck fistula end-to side portacaval shunts, and both of these were done during the last year of the study No shunts were performed for ascites alone Two of the 3 patients who were operated on for a huge spleen without history of bleeding had ascites but in both the ability to reduce it on a low sodium diet was demonstrated Neither was troubled by ascites postoperatively

The smallest diameter of vein used for anastomosis was 8 mm in a patient with the Cruveilhier-Barmgarten syndrome Portovenograms had revealed that the portal vein was also small and showed a filling defect, and it was considered unwise to interrupt the existing collateral circulation The shunt was judged adequate on the basis of disappearance of the bruit and no further hematemesis in over 2 years of follow up

Critical Evaluation of Venous Shunts for Treatment of Cirrhotic Patients with Esophageal Varices was made by Marvin M Nachlas[7] (Johns Hopkins Univ) Experimental and clinical literature relating to efficacy of venous shunt surgery in treatment of hemorrhage from esophageal varices supports the following findings (1) Portal hypertension is not solely responsible for variceal hemorrhage (2) In many patients, the procedure produces insufficient lowering of portal hypertension (3) Of patients operated on, 20% have recurrent hemorrhage in the follow up (4) Although many varices are smaller, they persist in 60% of surgically treated patients (5) Mortality from the operation in experienced hands closely approximates 20% in patients with intrahepatic obstruction (6) Some evidence indicates that the liver may sustain further injury by the marked reduction of portal flow that accompanies creation of an adequate venous shunt (7) There is no evidence that the prognosis of the patient having portal decompression is improved

Thus, it is justifiable to question the rationale and enthusiasm for advocating the venous shunt operation in treatment of variceal hemorrhage Extension of the operation to other patients who until now were not considered suitable candidates also appears to be unjustified

It remains to be seen whether it is possible for some other surgical procedure to alter the natural course of the cirrhotic patient with bleeding esophageal varices Since the problem is largely one of control of hemorrhage in the presence of varying degrees of liver damage, it seems reasonable to expect that any operative procedure will be associated with a significant mortality rate Nevertheless, continuation of surgical efforts to control the bleeding varix appears wise because with nonoperative treatment, 65% of the patients die within a year after the initial hemorrhage Some of the patients who bleed to death show apparently adequate liver functions

Side-to-Side Portacaval Anastomosis for Portal Hypertension W P Longmire, Jr , D G Mulder, P S Mahoney and S W Mellinkoff[8] (Univ of California, Los Angeles) used this technic in 18 of 28 patients

TECHNIC —A generous bilateral subcostal incision is made, with

(7) Ann Surg 148 169 183, August 1958
(8) Ibid. 147 881-894 June 1958

division of both rectus muscles and extension to the right as far laterally as possible (Fig 95) In some patients, it is advantageous to turn up a costochondral flap on the right side The hepatoduodenal ligament is exposed and the common duct identified, mobilized and gently retracted out of the way The hepatic artery is palpated and at times exposed to protect it The lateral peritoneal reflection along the first and second portions of the duodenum is incised and the duodenum and head of the pancreas mobilized to expose the portal vein The peritoneal incision is extended cephalad to expose the inferior vena cava If the caudate lobe is large enough to interfere with approxima-

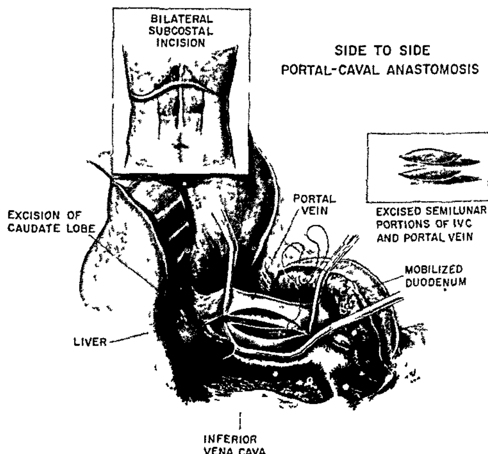


Fig 95 —Technic of side to side portacaval anastomosis (Courtesy of Longmire W P, Jr, *et al* Ann Surg 147 881 894 June 1958)

tion of the portal vein and inferior vena cava, a V-shaped area is excised from the intervening liver tissue (Fig 95) This is not unduly difficult in the scarred fibrotic liver of the cirrhotic patient Pressure in the portal vein is measured at start of surgery and after completion of anastomosis After adequate mobilization of the vessels the portal vein is occluded with two noncrushing clamps, one at the head of the pancreas, the other at the hilus of the liver The inferior vena cava is partially occluded with a Satinsky clamp, leaving an adequate lumen To prevent subsequent closure of the anastomosis, an elliptic segment is excised from the wall of the inferior vena cava and of the

portal vein at the site of the proposed anastomosis (Fig 95) The 2 veins are approximated with a continuous suture of 4-0 silk, interrupted in three places with stay sutures to prevent constriction of the anastomosis Diameter of the anastomosis is slightly larger than that of the portal vein In some patients with splenomegaly, the incision is extended to the left and splenectomy performed If hypersplenism is not marked, it is probably preferable to leave the spleen in place because decrease in size may be anticipated after adequate portacaval anastomosis

Side-to-side anastomosis preserves the normal pathway of portal blood to the liver Some evidence suggests that with transient changes in portal pressure associated with normal activities a portion of portal blood may intermittently pass beyond the shunt into the liver and may be partly responsible for the satisfactory results obtained

End-to-side and splenorenal anastomoses were done in 1 patient each A portacaval shunt was constructed in 3 patients, without benefit Transesophageal suture of varices was done five times as an emergency procedure to control massive bleeding, with 2 operative deaths, bleeding in 1 was still satisfactorily controlled 3 years later No immediate postoperative deaths occurred after 19 portacaval anastomoses for bleeding esophageal varices, but 2 patients died of liver failure 2 months and 1½ years after operation, 3 were living and well over 5 years later and 7 over 2 years later

Surgery of Portal Cirrhosis of Liver. Surgery is indicated primarily for prevention of hemorrhage from esophageal varices and also for relief from ascites uncontrollable by medical measures Robert R Linton[9] reports that from 1946 to 1950, 65 patients were admitted to Massachusetts General Hospital because of portal cirrhosis with bleeding esophageal varices Some type of portacaval shunt was performed in 33 (51%), and the other 32 (49%) died directly or indirectly of esophageal hemorrhage while attempts were being made to prepare them for shunt surgery Exsanguination was the cause of death in 23 (72%), and in 9 (28%), it was a major contributing factor to death because of liver failure

Since then patients with severe exsanguinating esophageal hemorrhage have been treated as surgical emergencies by cardioesophageal tamponage with an intragastric balloon The blood volume is then restored by repeated blood transfusions and within a few hours, unless in impending

(9) Am J Med 24 941 947, June 1958

liver failure, the patient is taken to the operating room for suture of esophageal varices through a transthoracic trans esophageal exposure This procedure controls the bleeding in most patients for 6 weeks to 2 months, thus permitting more thorough preparation for the larger procedure of con structing a portacaval shunt During the past 7 years, about 30 patients were so treated and 24 survived Whether or not to perform shunt surgery in a patient with a seriously dam aged liver does not depend on liver function tests alone, ex cept when the serum albumin level is below 3 Gm /100 ml, but also on general condition

Shunt surgery was done in 173 patients with bleeding esophageal varices secondary to liver cirrhosis, with 21 deaths (12%), partly due to uncontrollable hemorrhage from the operative field in early cases In the past 5 years, no deaths occurred from postoperative hemorrhage in 93 shunt procedures One to three fresh blood transfusions during op eration and use of hypotensive spinal anesthesia have been important factors in this improvement Splenorenal shunt was performed in 122 patients, and direct anastomosis be tween the portal vein and inferior vena cava was made in 51

Follow up for a year or over was possible in 66 with end to side splenorenal anastomosis and in 26 with direct porta caval anastomosis Recurrent esophageal bleeding occurred in 11 (17%) with splenorenal shunt, it was mild in 4 (6%) and major in 7 (11%), with 2 deaths (3%) Among patients with portacaval anastomosis no minor bleeding occurred and in only 3 (12%) did major bleeding develop, in each of these, the portal vein was thrombosed and a thrombectomy was necessary to construct the shunt In contrast with the incidence of esophageal hemorrhage in patients in whom shunts were constructed, all of 9 patients in whom shunts were attempted but could not be constructed because of dis eased portal veins and previous splenectomies had severe recurrent esophageal bleeding

Comparison of this surgically treated group with patients admitted during 1934-45 because of bleeding esophageal var-ices secondary to cirrhosis of the liver who were conserva tively treated showed that survival after 1 year was 80% and 50%, respectively, and after 5 years 50% and 20%

Liver function tests showed improvement in some pa-tients, e g, in 62 determinations, the serum albumin level

was higher than the preoperative level in 29%, unchanged in 53% and lower in 18% Of 78 patients with shunt operations who were followed 1-8 years, 52 (67%) returned to full-time work, 17 (22%) to part-time work and 7 (9%) were unable to work because of age or disability secondary to liver disease Among 119 patients followed 1-9 years after operation, 26 (22%) late deaths occurred, 15 (18%) among 85 with splenorenal shunts In 8 (9%), death was unrelated to liver disease Among 26 patients with direct portacaval shunt, 6 (18%) died of liver failure and 2 (6%) of cerebral hemorrhage, 3 (9%) additional deaths were unrelated to liver disease Both early and late postoperative mortality rates were higher after direct portacaval shunts Thus, even though construction of a splenorenal shunt is more difficult, it is the preferred procedure

Nitrogen Metabolism after Portacaval Shunts in Patients with Cirrhosis: I Effects of Operation on Blood "Ammonia" Concentration were studied in 13 patients by Thomas C Chalmers, Carl W Hughes and Frank L Iber[1] (Walter Reed Army Med Center), with the technical assistance of Marjorie Knowlton, Barbara Stowers and Anna Marie Link In 8 of 11 patients, ammonia levels rose immediately after operation, and the level was probably elevated in 2 without preoperative control values Most patients showed a drop to preoperative levels after about a week Mean levels were 1 19 µg for the preoperative control period, 1 59 µg for the 1st postoperative week and 1 17 µg for the 2d postoperative week

All patients showed a rise of 0 1-4 2 mg /100 ml in the total serum bilirubin level immediately after operation No significant correlation was noted between magnitudes of individual rises in bilirubin and ammonia concentration The EEG's in 2 patients at time of elevated blood ammonia levels were normal Marked abnormalities were noted in 1 of the 2 a month after operation, when he received 8 Gm ammonium chloride/day for 4 days, 5 days later the EEG was again normal, and a month later the syndrome could not be reproduced on repeated administration of ammonium chloride

Measurements during surgery in 2 patients showed a rise in ammonia levels associated with the operation In 1, a sharp rise occurred after the shunt was opened with return

(1) A M A Arch Int Med 101 434 438 February 1958

to almost preoperative level by the time the skin was sutured In the other a steady rise was noted throughout the operation with a drop at its end and opening had no additional effect *Postoperative rise in ammonia levels may be largely a result of liver cell dysfunction accompanying the operation*

Technic for Temporary Control of Bleeding during Transesophageal Suture Ligation of Esophageal Varices Every surgeon with occasion to attempt hemostasis for bleeding esophageal varices through a transthoracic approach must have been impressed with the rather alarming blood loss that follows incision through the esophageal wall Vision is obscured thus prolonging the procedure and making it technically more difficult R Maurice Hood[7] (US Naval



Fig 96—Technic with use of 2 tourniquets (Courtesy of Hood R M Surg Gynec & Obst 106 749 750 June 1958)

Hosp Oakland Calif) devised a simple easily accomplished technic

TECHNIC—After the left pleural space is opened the esophagus is rapidly mobilized 1 2 cm above the diaphragm by finger dissection A ¼ in umbilical tape is placed around the esophagus at this point and incorporated into a Rommel tourniquet The intraluminal balloon is deflated and removed Moderate constrictive pressure is exerted to occlude the varices With the tourniquet in place a 10 15 cm longitudinal incision is made through the wall of the esophagus The varices are oversewed with a suture ligation technic If hemostasis is not complete another tourniquet may be applied just below the aortic arch (Fig 96)

► [In our experience with the transabdominal transgastric method of suture ligation of esophageal varices the bleeding points have often been found in the stomach distal to the esophagogastric junction Closure of

(7) Surg Gynec & Obst 106 749 750 June 1958

these bleeding points by the method described above would be extremely difficult if not impossible For this reason and because the varices in both the distal esophagus and the stomach may be visualized and sutured by the transabdominal transgastric method this approach is preferred —Ed]

Bleeding Varices Due to Cirrhosis Survival after (1) Nonsurgical Treatment, (2) Splenectomy with or without Omentopexy, and (3) Portacaval and Splenorenal Shunts. George A Hallenbeck, Morton S Comess, Eric E Wollaeger and Robert P Gage[3] (Mayo Clinic and Found) compared results of operation in a group of patients with cirrhosis of the liver who had splenectomy with results in a group now being treated by shunt procedures

Records were examined of all patients who had splenectomy at the Clinic between 1909 and 1947 in whom diagnosis had been cirrhosis of the liver, Banti's syndrome or splenic anemia Two criteria were used to select patients for study, viz , a history of bleeding from the gastrointestinal tract before splenectomy was performed and irrefutable diagnosis of cirrhosis of the liver These criteria were satisfied by 75 patients, in 24 of whom omentopexy had been performed together with the splenectomy

Data on 54 patients with cirrhosis of the liver who bled preoperatively but who had splenorenal or direct portacaval shunts constructed from 1 to 6 years previously, was studied as well These were selected for operation according to Linton s criteria

Survival rates for both groups during the first 5 years were similar A greater incidence of postoperative bleeding was noted among those with splenectomy than among those treated by portal-venous shunts Survival rates for patients who had splenectomy or portacaval shunts were compared with those for four published series of patients with gastrointestinal bleeding associated with cirrhosis of the liver who did not have surgical treatment The argument was advanced that the principal reason for better survival in the surgical groups is that in selecting patients for operation those likely to survive longest were considered

This study suggests that splenectomy with end-to-side splenorenal anastomosis gives results superior to those after splenectomy alone or end to side portacaval anastomosis More data and longer observation are needed to establish this point beyond question or to disprove it

(3) A M A Arch Surg 78 774-785 May 1959

Treatment of Cirrhotic Ascites by Combined Hepatic and Portal Decompression is considered by William V McDermott Jr[4] (Harvard Med School) There is considerable experimental and clinical evidence that an intrahepatic outflow block is the major factor instigating the complicated physiologic and endocrine disorders that result in the accumulation of ascites in cirrhotic patients

In 6 patients disappearance of ascites and rapid and complete reversal of the metabolic pattern of sodium and water retention (hyperaldosteronism) resulted from use of a double end to side portacaval shunt (double shunt) that achieved both hepatic and portal decompression This experience further supports the outflow block concept in the pathogenesis of cirrhotic ascites and suggests that fluid electrolyte and endocrine abnormalities are secondary to the basic disturbance in hemodynamics In 1 patient albumin levels were consistently above 3 Gm /100 ml and did not change appreciably during the study, so osmotic pressure relations remained constant and were not a factor in this patient

► [The excellent studies by this investigator would support the concept that hepatic outflow block is an important factor in the physiologic and biochemical derangements of this condition It is difficult to understand however why the procedure described by the author as a double portacaval sh[illegible] hepatic decompression than the [illegible] ide anastomosis since this de

Peptic Ulcer Following Portacaval Shunt is reported by James S Clarke Robert S Ozeran, James C Hart Kenneth Cruze and Valda Crevling[5] (Los Angeles) Among 62 patients with portacaval shunts, 4 showed peptic ulcers within a year after the shunts A fifth patient showed worsening of a pre existing ulcer after the shunt The development or aggravation of ulcers in these 5 patients their occurrence soon after the shunt and their severity, strongly suggest a casual relation

In experimental studies on dogs secretion of acid from a Heidenhain pouch was profoundly increased after portacaval transposition The increase was markedly reduced by fasting unaffected by oral neomycin and persisted after resection of the gastric antrum

In forming a Heidenhain pouch the vagus nerves running

(4) New England J Med 259 897 901 Nov 6 1958
(5) Ann Surg 148 551 564 October 1958

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Treatment of Cirrhotic Ascites by Combined Hepatic and Portal Decompression is considered by William V McDermott, Jr[4] (Harvard Med School) There is considerable experimental and clinical evidence that an intrahepatic outflow block is the major factor instigating the complicated physiologic and endocrine disorders that result in the accumulation of ascites in cirrhotic patients

In 6 patients, disappearance of ascites and rapid and complete reversal of the metabolic pattern of sodium and water retention (hyperaldosteronism) resulted from use of a double end-to-side portacaval shunt (double shunt) that achieved both hepatic and portal decompression This experience further supports the outflow block concept in the pathogenesis of cirrhotic ascites and suggests that fluid electrolyte and endocrine abnormalities are secondary to the basic disturbance in hemodynamics In 1 patient, albumin levels were consistently above 3 Gm /100 ml and did not change appreciably during the study, so osmotic pressure relations remained constant and were not a factor in this patient

► [The excellent studies by this investigator would support the concept that hepatic outflow block is an important factor in the physiologic and biochemical derangements of this condition It is difficult to understand however, why the procedure described by the author as a 'double portacaval shunt should provide more portal and hepatic decompression than the technically simpler procedure of side to side anastomosis, since this depends on the gradient of pressure —Ed]

Peptic Ulcer Following Portacaval Shunt is reported by James S Clarke, Robert S Ozeran, James C Hart, Kenneth Cruze and Valda Crevling[5] (Los Angeles) Among 62 patients *with portacaval shunts, 4 showed peptic ulcers* within a year after the shunts A fifth patient showed worsening of a pre-existing ulcer after the shunt The development or aggravation of ulcers in these 5 patients, their occurrence soon after the shunt and their severity, strongly suggest a casual relation

In experimental studies on dogs, secretion of acid from a Heidenhain pouch was profoundly increased after portacaval transposition The increase was markedly reduced by fasting unaffected by oral neomycin and persisted after resection of the gastric antrum

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route In the other 10 cases, atypical resections were performed because preliminary ligation of the vessels was difficult or to avoid a waste of healthy hepatic tissue

These last cases demonstrate the advantages of resections which, though called atypical, were always oriented as much as possible according to the intrahepatic biliovascular topography For hepatovesicular neoplasms, the excision can assume different directions without interrupting the circulation of the centrocranial pedicle of the portal vein and the right suprahepatic branch By careful attention to vascular anatomy and technical improvements in hemostasis, atypical resections may be regarded as controlled procedures, with increased possibilities of application

Of the 13 patients operated on, 2 with malignant adenomas of the right lobe died of hepatic insufficiency due to tumor invasion in the left lobe Another patient with a massive vascular neoplasm died 4 months after operation because of extension of the tumor in remaining parenchyma In 1 patient with a polycystic liver associated with cirrhosis, there was progression of the cirrhosis after 6 months The other 9 patients were followed 1-4 years and are in good health

Elective Right Hepatectomy for Hepatoma. P Santy, H Viard, P Charnay, J L Desgouttes and G Braillon[8] report a case

Woman, 43, had acute cholecystitis, for which cholecystectomy was performed Biopsy of a nodular tumor discovered in the liver proved it to be a primary hepatoma Splenoportography confirmed localization in the right lobe and revealed a trifurcation of the portal vein by division of the right branch into centrosuperior and lateroinferior veins Hepatectomy was decided on, since the patient was in good general condition Because of the portal anomaly, cholangiography was performed during operation The right branch of the hepatic canal showed an early trifurcation, but a common trunk could be isolated, which was long enough so only a single section was required between two ligatures

Thoracophrenolaparotomy permitted control of the inferior vena cava below and above the liver The pedicular stage of operation was the most difficult, there was an intraparenchymatous hilus, which necessitated a short primary section of the parenchyma in relation to the pedicle Primary section of the vascular elements aided dissection of the biliary canal No difficulty was met in the subhepatic stage, which was accomplished by liberation of the inferior vena cava from below upward, then isolation and successive ligation of three right

(8) Lyon chir 54 475 480 May, 1958

subhepatic veins, two inferior and one median, accessory veins an main superior vein were carried out. The practically bloodless pa renchymatous section was made perpendicularly along the line of color change. This apparently was not adequate, and a little dead hepatic tissue must have been left in place, because for 2 months there was thoracic and abdominal drainage of debris that must have been necrotic hepatic tissue.

Biliary closing was controlled by injection of methylene blue through the transcystic cannula. Since no trace of blue appeared in the cut edge of the liver, closure was assumed to be perfect, but results after operation showed that it was not. A significant amount of bile-serous fluid was discharged through the abdominal drain and then through the transpleural drain until the 6th week. The test of closure was in error because the cannula had not been directed toward the skin, and the bile duct was poorly clamped below. Aside from these local complications, the postoperative course was uneventful, except for marked edema which disappeared when proteins were corrected. Liver tests were never alarming.

To avoid the difficulties experienced in this case, the authors suggest the following changes in technic. Isolation by the subhepatic route of the median sagittal and right subhepatic veins would make the subhepatic stage less simple, but the section should follow the right edge of the sagittal vein, a valuable guide to the grand scissura. The grand scissura should not be perpendicular but oblique, from left to right and from top to bottom, making with the inferior surface of the liver a 75-degree angle to the left sinus. Section of the hepatic parenchyma should follow this direction.

Elective hepatectomy should be preferred to limited resections in tumor of the liver, because it constitutes, in most cases, a less hemorrhagic and more effective procedure. It is definitely indicated in treatment of primary isolated tumor or of secondary metastatic tumor if the single metastasis supervenes sufficiently late after removal of the primary tumor

Splenosis: Autotransplantation of Splenic Tissue Following Injury to Spleen; Report of Two Cases and Review of Literature is presented by Alvin M. Cotlar and Elmo J. Cerise[9] (New Orleans).

Boy, 12, fell 15 ft. from a ladder. He became unconscious but revived quickly. Thirty minutes later, he had left-sided abdominal pain radiating to the left scapular area. About 4 hours after the accident he was hospitalized. Physical examination revealed abdominal rigidity, generalized tenderness, most severe in the left upper quadrant, distention and absence of bowel sounds. Laparotomy revealed a large

(9) Ann. Surg. 149:402-414, March, 1959.

laceration of the spleen with a hemoperitoneum of over 1 000 cc Splenectomy was performed

He was rehospitalized 5 years later with a 2 day history of colicky

ty associated with nausea and
year earlier that subsided spon
there was tenderness over the

upper part of the left sided splenectomy scar hyperperistalsis and slight abdominal distention Abdominal x ray films revealed a me chanical small bowel obstruction in the left upper quadrant He was operated on and found to have volvulus of the jejunum in the upper third secondary to adhesions Lysis easily relieved the obstruction

Over the greater omentum small intestines and the mesentery of the small bowel were many nodules resembling splenic tissue vary ing in size from freckles to as large as the end of the thumb Biopsy was done on the mesentery containing this tissue The patient did well postoperatively Biopsy specimens were identified as autoplastic splenic transplant resulting from traumatic rupture of the spleen

Among the 36 reported cases of splenosis (including the authors 2) there is no single instance of this condition hav ing been diagnosed before visualization of the tissue Sple nosis then has no characteristic clinical picture Of the 36 patients with splenosis, in 9 diagnosis was made at oper ation for intestinal obstruction The authors other patient represents the only known instance in which intestinal ob struction was directly due to the splenic transplant in the remaining 8 patients postoperative adhesions caused the mechanical ileus

Splenosis occurred in 25 males and 10 females in 1 report the sex was not stated Diagnosis was made most com monly in patients in the 2d and 3d decades History of pre vious splenectomy for traumatic rupture of the spleen was given by 29 patients

Peritoneal splenosis has been mistaken initially for endo metriosis metastatic carcinoma sarcoma and angioma of the bowel wall Microscopically the implant may have all the constituents of normal spleen or only the red pulp to identify the tissue as splenic in origin

Anemia and the Spleen were studied by Arno G Motulsky Fredrick Casserd Eloise R Giblett Goronwy O Broun Jr and Clement A Finch[1] (Univ of Washington) Explana tions of the mechanisms whereby anemia is produced by the spleen range from erythroid bone marrow inhibition to in creased red cell destruction In extensive studies using a bat tery of measurements of red cell production and destruction

(1) New England J Med 259 1164 1169 Dec. 11 1215 1219 Dec 18 19 9

the authors found no evidence of splenic inhibition of erythroid bone marrow function in patients with splenomegaly, but obtained consistent and abundant evidence of increased red cell destruction.

Excessive trapping and destruction of red cells within the spleen may be due to an abnormal erythrocyte or an abnormal spleen. Though stasis may be of importance in the chain of events leading to hemolysis, the factors involved in effecting phagocytosis are obscure. The capacity of the spleen alone to destroy cells does not appreciably exceed the capacity of the normally responsive bone marrow to produce red cells. Thus, the presence of a significant degree of anemia with splenic hemolysis implies destruction of blood in other areas of the body as well or associated impairment in erythropoiesis.

With the exception of hereditary spherocytosis, it is not possible to predict with certainty the effect of splenectomy on a hemolytic process. Patients with anemia from diseases ordinarily assumed to be little affected by the spleen, i.e., sickle cell disease, thalassemia and myeloid metaplasia, have been shown with increasing frequency to have splenic destructive mechanisms and have benefited by splenectomy. Thus, it seems important when splenomegaly is present to evaluate splenic hemolytic activity. The most useful current methods of clinical evaluation are the measurements made after injection of the patient's cells tagged with Cr_{51}. These include, first, demonstration of a shortened half-life of cells. Dependable evidence of a significant hemolytic process is furnished by a Cr_{51} half time of less than 20 days. Quantitative studies of the rate of hemolysis are important in evaluating the potential value of splenectomy. Little benefit from splenectomy is obtained in anemia unless a hemolytic process with cell destruction of over twice normal is present. The second method is determination of the splenic mixing time and of the spleen-liver ratio an hour after injection of cells. A ratio of 2 or more indicates significant red cell sequestration.

Observations on 60 Splenectomies performed within 5 years are presented by Lucien Leger, Philippe Heuze and Paulette Guyet[2] (Paris). Cases were excluded in which spleen removal was an accessory procedure during opera-

(2) J chir 76 521 548 November 1958

tion on neighboring organs In 36 of the 60 cases, splenectomy was the only intervention In 18, the spleen was removed as the first stage of a portacaval radicular anastomosis Splenectomy was associated with cholecystostomy in 2, and with ligature of the esophageal varices, ligature of the common hepatic artery, removal of an aneurysm of the splenic artery and partial left hepatectomy, and colon suture following injury in 1 each

Cases were classified as splenic rupture in 15, splenomegaly due to portal hypertension in 35, aneurysm of the splenic artery in 1, tuberculosis of the spleen in 2, hemopathy in 2, splenic cyst in 1 and malignant disease in 4 Three of the splenic ruptures were due to splenoportography, the only accidents which occurred in 700 patients on whom this procedure was performed All 3 recovered after splenectomy

Review of the 60 splenectomies suggests that this operation is not without its disappointments and risks but that it is not so formidable as it was previously Except in 1 patient with malignancy, febrile before operation, and 1 with splenic tuberculosis, the classic hyperthermia the day after splenectomy was not observed There were, however, 4 cases of postoperative parietal hemorrhage which necessitated reoperation several hours after splenectomy These patients had hematologic disturbances before operation 2 had cirrhosis with hypoprothrombinemia, 1 had purpura probably of tuberculous origin and 1 myeloid leukemia

Total mortality was 20% (12 persons), including 1 who died of tuberculous cachexia after 2 months and 1 who succumbed after 3 months to intestinal fistulas following severe trauma If these 2 cases are excluded there were 10 deaths (17%) in 58 splenectomies Five deaths (15%) occurred in patients who had splenectomy alone One of these had splenectomy for severe injury, 1 for advanced Banti's disease 1 for hemolytic icterus (aged 61) with cardiac insufficiency and 2 for malignancy There were 4 deaths (22%) following 18 splenectomies combined with portacaval radicular anastomoses Of these 2 had Banti's disease with hepatic coma for 10 and 15 days respectively 1 had infantile cirrhosis (15th day), and 1 had portal hypertension and recurrence of hematemesis by thrombosis of the anastomosis (death occurred the 15th day and splenic tuberculosis was discovered) There was 1 death (16%) after ligation of esophageal varices

in a cirrhotic patient among 6 splenectomies combined with various other procedures.

In the authors' surgical experience, 24 of 60 splenectomies were combined with various procedures much more complex than splenectomy alone (which is merely the first stage) without significant increase in mortality. The statistics tend to prove that, apart from splenectomy for trauma in which prognosis depends on associated lesions, the etiology of the syndrome plays an essential role. Tuberculosis of the spleen, if identified, appears to constitute a surgical contraindication. In portal hypertension, etiology is of prime importance. Hepatosplenic schistosomiasis, despite extreme cachexia of the patients, responded satisfactorily to portacaval operations. Banti's disease and alcoholic cirrhoses constitute fragile bases, especially when complications—hemorrhages, hepatic insufficiency, ascites—are present, as they usually are. Precautions of preoperative restoration of protein balance and of anesthesia under hypothermia are highly desirable in these cases.

Earlier operation, when hepatic disease is less advanced, should be the aim of surgical treatment, with the hope of definitely improved results.

THE BILIARY TRACT

Acute Cholecystitis. II. Timing of Cholecystectomy: Study on Postoperative Course in 895 Cases is reported by Yngve A. Edlund and Olof J. Olsson[3] (Univ. of Gothenburg). Cholecystectomy was performed in 98% of the patients, cholecystostomy or drainage alone in the others. Mortality during the first 8 years was 19 (7.4%) of 258 patients and during the second 8 years, 17 (2.7%) of 637. About one fourth required emergency operation (group 1); of these 251 patients 22 (8.8%) died. Among 644 patients who had nonemergency operations (group 2), 14 (2.2%) died. Most of those who died were over age 60.

In group 1, operation disclosed perforation of the gallbladder in 56 of 261 patients with fatal outcome in 9 (16%). The relative incidence of perforation was higher the longer the duration of the condition. Mortality was highest (17.3%)

(3) Acta chir. scandinav. 115: 284-298, 1958.

difficulty. Even when a patient with postcholecystectomy distress presents the whole constellation of clinical symptoms and objective signs favoring hypertonic biliary dyskinesia, it is necessary to make sure that there is no disease within the ducts and no organic change in the sphincter. This may require surgical exploration and even transduodenal exposure and biopsy of the choledochal sphincter.

► [*Berk has presented an excellent discussion of symptoms arising from* abnormalities in the biliary tree. It must be emphasized, however, that symptoms referable to the upper abdomen which persist or develop after cholecystectomy are due most commonly to disease or lesions of organs other than the biliary tract, such as hiatal hernia, duodenal ulcer and *pancreatitis.—Ed.*]

Cystic Duct Remnant: Cause of Biliary Distress Following Incomplete Cholecystectomy. Teuvo K. I. Larmi and Gustav Fock[5] (Univ. of Helsinki) present a survey of 241 patients previously reported on, in whom distress after cholecystectomy was ascribed to presence of a cystic duct remnant, and report 13 additional cases.

The *main symptom* was pain, which usually occurred after a pain-free interval of 1 month to 5 years (average 2.7 years) after cholecystectomy. The pain was stimulated by greasy fried foods and in some patients also by eggs, apples and spices. Transitory jaundice was present in 6 of the 13 patients. Stones in the common bile duct were not demonstrable in any but were found at operation in 2 with jaundice. Inflammatory cellular infiltration was histologically demonstrated in the cystic duct remnant in 5 patients, 1 of whom had jaundice. In 2 patients, a small portion of the neck of the gallbladder was found at surgery besides the cystic duct remnant. In 9, the cystic duct remnant was inserted into the lateral aspect of the bile ducts; in 1, into the posterior aspect of the common duct; in 1, into the medioanterior aspect of the common bile duct near the hilar region of the liver; and in 1, into the ventral portion of the common duct, to which it was rather firmly adherent along its entire length. In 1, the cystic duct remnant was wound around the common duct and inserted into the medial aspect.

After surgery, 11 patients were asymptomatic, 2 showed occasional mild pain and vomiting and 1 was still hospitalized.

► [The problems which may arise as a result of cystic duct remnant are

(5) Acta chir. scandinav. 114:367-378, 1958.

well documented by these authors In the United States, however, common duct stricture following cholecystectomy is a much more serious problem It should be pointed out that in removal of the gallbladder 2 3 mm of the cystic duct should be left intact so that ligation of the duct is not actually performed flush with the common duct A segment of duct this length will rarely, if ever, result in production of symptoms—Ed]

Choledochostomy: Follow-up Report on 350 cases is presented by N A Goldsmith and H K Ransom[6] (Univ of Michigan Hosp) Surgical procedures included 389 choledochostomies and 18 operations to treat nonbiliary complications following choledochostomy

A minimum 2-year follow-up was obtained in 95% Results were classified as excellent (freedom from any symptom or complication even remotely related to the biliary tract or the operation), good (occasional minor gastrointestinal upsets, psychosomatic complaints or small wound imperfections) or poor (missed—retained—stones, newly occurring or recurring inflammatory strictures, operations for extrabiliary complications after duct exploration and death after discharge from causes related to the original disease or operation) A summary of the results is shown in the table

Nonfatal complications exclusive of those affecting the biliary system occurred 64 times among 42 patients (10 8%)

RESULTS OF CHOLEDOCHOSTOMY

Results	No	%
Excellent	257	73 4
Good	43	12 3
Total satisfactory		85 7
Poor		
Cholangitis re exploration or late death from cause related to primary disease	35	10 0
Operative deaths*	15	4 3
Total unsatisfactory		14 3

*From a total of 407 operations including repeat explorations and procedures required to treat nonbiliary surgical complications

Operative mortality was 7 3% in men and 2 9% in women, over all operative mortality for the 389 operations was 4 3% Seven of the patients who died in hepatic coma were jaundiced at the time of operation and had been for 2-12 months

Among 17 patients with persistently positive x-rays and clinical symptoms of obstruction retained stones were removed in 12 and repeat exploration had been advised for 5 In one of the 2 cases discovered at autopsy, an impacted

(6) Surgery 44 868 876 November 1958

stone was found in a secondary duct within the liver, which had not contributed to death In the other patient, hypotension caused termination of the operation before it was completed The duct was explored, but previously planned cholecystectomy could not be performed A retained cystic duct stone caused death from a ruptured gallbladder 3 months after operation The patient was asymptomatic until a few days before death

Combination of jaundice, chills and fever are the most important symptoms indicating need of duct exploration Ductal dilatation and presence of palpable stones in the duct also indicate that choledochostomy must be performed Incidence of stones recovered at choledochostomy was 34% Danger of overlooking stones at time of duct exploration is greatest when 1 or more stones are recovered and the surgeon assumes that there are no more Stones were missed 7 times as often in duct explorations positive for calculi as in those originally considered negative Incidence of recurrent difficulty is usually proportional to degree of abnormality present at the first operation

Common Duct Stones. Bentley P Colcock[7] emphasizes the fact that the presence of common duct stones and the need for choledochostomy should be carefully considered for every patient having cholecystectomy Operative cholangiography may be used as an aid in determining the need for choledochostomy, but it is not a substitute for adequate clinical evaluation on the operating table Hospitalization may be increased by a few days by common duct exploration, but addition of choledochostomy per se does not appear to increase mortality

Common duct stones were found in 13 3% of 2,460 patients operated on for biliary tract disease over 8 years Incidence decreased from 16 8% in the first 4 years to 10 4% in the second 4 years Incidence of common duct exploration also dropped slightly from 45 7% to 36 7% The percentage of common duct stones found in ducts explored dropped from 36 7% to 28 5% Thus common and hepatic ducts are explored in slightly over one third of the patients and stones are found in slightly under one third of the ducts explored

The commonest symptom of common duct stones is abdominal pain, which was present in 91 5% Jaundice or his-

(7) S Clin North America 38 663 672 June 1958

tory of jaundice was present in 56 3% of the total group and in 63 4% of 1,356 patients operated on during the second 4 years Nausea and vomiting were present in 68 7% of those with common duct stones and in 48 7% of the entire group Of the 1,356 patients, fever occurred as often in those with common duct stones (35 9%) as in those with acute or sub acute cholecystitis (32 1%)

Dilated common duct is the commonest and one of the most dependable indications for choledochostomy, it was present in 55 8% of the ducts explored and stones were found in 42% Jaundice was the indication in 41 8% of the patients and stones were found in 43 2% Pancreatitis, when present, is strong indication for choledochostomy, the common duct was explored for this indication in 8 2% of the patients and stones were found in 48 7% Positive or suspicious findings on palpation were present in only 2% of the patients, but stones were found in the ducts of all 10 patients in this group Small stones in the gallbladder were present in 33 5% of the patients who had exploration of the ducts and stones were found in 25 1% In 6 patients it was the only indication that common duct stones were present Common duct stones were found in 24% of those with acute or subacute cholecystitis, three times the number noted in chronic gallbladder disease

Mortality for the 2,460 patients was 1 05% Mortality among patients who had cholecystectomy and choledochostomy was 1 1%, among those who had cholecystectomy alone, 0 9%, and among those who had cholecystectomy and negative choledochostomy, 0 6%

Bile Duct Repair Aid to Identification of Hilar Structures is evaluated by Clare G Peterson and William W. Krippaehne[8] (Univ of Oregon) In a clinical instance requiring biliary reconstruction, a series of previous surgical misadventures and attempts at common duct repair led to the total destruction of the extrahepatic duct system Long, dangerous dissection in the hilar region was unsuccessful At this point, the problem of the search for a proximal intrahepatic portion of the bile duct system was resolved, quickly and safely, by an operative maneuver

PROCEDURE.—A tangential slice was made in the superior surface of the left lobe of the liver A peripheral bile duct was cannulated with

(8) Ann Surg 149 515 518 April 1959

the smallest size Bakes dilator and the tip of the dilator was advanced without difficulty to the hilar zone of the liver (Fig 97) With this visible and palpable advantage, safe, rapid hilar dissection was possible and an intrahepatic Roux-Y choledochojejunostomy was effected At completion of the hilar dissection the Bakes dilator was withdrawn and the incision in the liver was closed with mattress sutures

The technical maneuver illustrated in Figure 97 may have only rare application, but it would seem reasonable to consider its use before selecting alternatives The possibility should be considered that a sufficiently large bile duct may not be found for the autograde cannulation of the peripheral

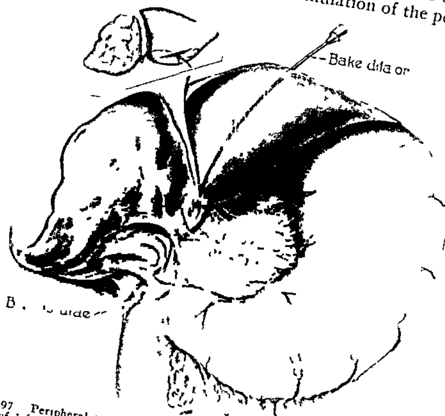


Fig 97 Peripheral transhepatic autograde cannulation of small bile duct in cut surface of left lobe of liver with advancement of tip of Bakes dilator to hilar zone visible and palpable aid to identification of hilar structures and proximal hepatic duct segment (Courtesy of Peterson C G and Kripaehne W W Ann Surg 149 515 518 April 1959)

biliary duct system in the left lobe of the liver If necessary, it would seem feasible to carry out left liver lobe transections on anatomic planes until a sufficiently large biliary radical is found Goldsmith and Woodburne have indicated the surgical anatomy pertaining to liver resection and have shown

that resection of a peripheral portion of the left lobe of the liver can be done using anatomic technics that place surgical planes in relation to the portal and hepatic veins (cf, left lateral segmental resection plane) Strict adherence to paralobar or parasegmental planes that are favorable anatomically should avoid isolation of large areas of liver from their proper blood vessels and bile ducts

There are obvious risks to the procedure, but it should prove of some value as an additional operative maneuver to assist in identification of intrahepatic hilar duct structures when the extrahepatic duct zone dissection has been successful

Strictures of Bile Duct, over 90% of which are probably caused by faulty technic of cholecystectomy, carry a high morbidity and an appreciable mortality Richard B Cattell and John W Braasch[9] point out certain precautions and safeguards during operation which in most instances will avert this complication Most important is careful dissection and accurate identification of the structures at the hilus of the liver before any vascular or biliary structures are interrupted The surgeon must be aware of common anatomic abnormalities in this area e g, a short cystic artery which arises from a right hepatic artery near the cystic duct a double cystic artery, and a cystic duct which empties into a right hepatic duct

Repair of bile duct strictures is one of the most difficult procedures in general surgery Principles of repair are those encountered in general abdominal surgery, an accurate mucosa-to mucosa anastomosis between the bile ducts without tension and use of an indwelling tube which prevents contraction of the anastomosis (Fig 98)

The authors' best results have been obtained with a plastic procedure done on the duct or with an end-to end anastomosis between the upper and lower ends of the duct They prefer an end to-end anastomosis between the ends of the duct and insertion of a T tube within this anastomosis, the external limb of which is brought out through the normal duct above or below the anastomosis The operative approach to repair of these strictures is best accomplished by elevating the duodenum and head of the pancreas and

(9) S Clin North America 38 645 657 June 1958

identifying the common duct gland, which leads the surgeon to the bile duct

Of 112 patients treated during 1940-47, most of whom have been followed 10 years or more, 33 obtained a good or excellent result and 69 a poor result after initial repair After further repair in 64 patients, 68 were free from biliary obstruction and 9 were alive but had recurrence of obstruction There were 17 postoperative deaths, and 33 patients died of

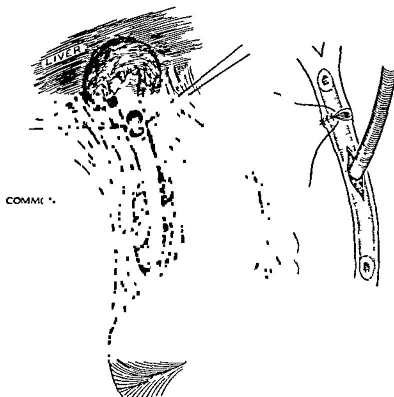


Fig 98 —Principles of repair of bile duct stricture Note mucosa to mucosa anastomosis of ends of duct with mobilization of head of pancreas and duodenum External limb of T tube emerges from duct below anastomosis (Courtesy of Cattell, R B and Braasch, J W S Clin North America 38 645 657, June, 1958)

the complication of biliary obstruction or of the operative repair In most cases, biliary obstruction after operative repair occurs within 3 years The authors believe that an eventual good result can usually be obtained if recurrent biliary obstruction is promptly treated surgically

► [The incidence of common duct stricture in America remains too high *This complication is the result of a preventable technical mishap in most* instances Its seriousness is well demonstrated by the fact that even in the hands of an experienced surgeon such as Cattell, the mortality rate following surgery is 15% and the total mortality from surgery plus the complication of the disease is 40% This mortality is as high as that for

many types of carcinoma Furthermore, simple statements of mortality cannot in any way express the long periods of suffering and multiple operative procedures which many of these patients endure The need for accurate careful dissection during cholecystectomy cannot be overemphasized —Ed]

THE PANCREAS

Manometric and Radiographic Experimental Functional Exploration of Pancreatic Duct: II. Analysis of Effects of Increased Pressure in Wirsung's Duct on Pancreatic Parenchyma P Mallet-Guy, J Feroldi, R Vidil, J Foray and P Tavares[1] report on 58 experiments on dogs, totaling 108 procedures Because of technical error or anatomic defect, 11 animals were excluded The rest were divided into three groups according to whether the gland was in an active or inactive secretory state or the left splanchnic nerve was stimulated when pressure in the duct was increased

Pressure of 25 cm water in the pancreatic duct can cause some benign edematous lesions Pressure of 30 cm water represents definitely the threshold at which the risk becomes great and edematous lesions can be observed for 4 days after injection of a saline solution, these are more severe if India ink is added to the solution The severity of pancreatic lesions increases with an increase of pressure in Wirsung s canal and their duration is prolonged The lesions last 5 days with a pressure of 50 cm water and 6-15 days with a pressure of 70 cm water

Lesions thus produced when they are not lethal appear to be curable spontaneously in 15-30 days and apparently do not progress to a recurring chronic syndrome This lability of the lesions suggests that the mechanism of "chronic recurring pancreatitis" should not be sought solely in mechanical factors Histologically, the lesions progress from edema to hemorrhagic necrosis and have certain characteristics similar to those produced experimentally by section of the pancreatic sphincter, particularly fatty vacuoles which seem to manifest the canalicular mechanism of the pancreatic inflammation

These experiments accent the danger of retrograde injec-

(1) Lyon chir 54 321 342 May, 1958

tions into the pancreatic duct by the papillary route and also fixes the pressure level—very low—which should not be exceeded in pancreatography When pressure in Wirsung's canal is superimposed in an already diseased gland, the pathologic effect is probably aggravated and its curability decreased When the gland is in a secretory state and the left splanchnic nerve is stimulated electrically, effect of intraductal pressure is exaggerated and vasodilatation increased

Pancreatography in Diagnosis of Chronic Relapsing Pancreatitis A V Pollock[2] (Univ of Leeds) examined pancreatic ducts radiographically, after injection of radiopaque material, in 33 cadavers without clinical history of pan



Fig 99—Considerably dilated pancreatic ducts in patient with gallstones and right renal calculus There was no history suggestive of chronic relapsing pancreatitis (Courtesy of Pollock A V Surg Gynec & Obst 107 765 770 December 1958)

creatic disease and in 11 patients undergoing transduodenal division of the sphincter of Oddi mostly for recurrent pancreatitis

In most of the 44 pancreatograms it was impossible to say which were from patients with recurrent or chronic pancreatitis and which from patients with no suggestion of pancreatic disease Opacification of gland substance in acute pancreatitis is probably characteristic but it is of no assistance in diagnosis of such an obvious lesion For the rest the greatest dilatation was in patients with no history of pan

(2) Surg Gynec & Obst 107 765 770 December 1958

creatitis (Fig 99), and several patients with undoubted pancreatitis had pancreatic ducts of relatively small caliber The extreme rarity of strictures of the pancreatic duct was demonstrated Whenever the duct was dilated, this extended right up to the duodenal wall, providing a rationale for sphincterotomy The opening of the pancreatic duct was always in the ampulla of Vater, and in all obstruction at the sphincter of Oddi could have caused reflux of bile up the pancreatic duct

Of the 11 patients who underwent surgery, 1 died of disruption of the duodenal suture line, but this death could be blamed on poor timing of sphincterotomy in a patient with acute pancreatitis Eight patients recovered satisfactorily, although 2 had slightly elevated serum amylase (about 400 units/100 ml) and 1 had serum amylase of 2,000 units Frank acute pancreatitis developed in 2 patients, 1 of whom died The acute pancreatitis was probably due to injection of diodone into the pancreatic duct

Since little diagnostic information is gained by transduodenal pancreatography with diodone and as it carries a real danger of causing acute pancreatitis the method has been abandoned

► [Our experience supports the observation that pancreatography has little to offer in most patients with chronic inflammatory pancreatic disease It will be of use in the occasional patient in whom multiple strictures are suspected However, we agree with Pollock that the procedure is not without danger and therefore it should be utilized only when the information gained will significantly influence the proposed therapy —Ed]

Significance of Serum Amylase Determination. It is routine procedure to request analysis of serum amylase for any patient with symptoms and signs of an acute abdominal condition An elevated serum amylase level is taken as indication of acute pancreatitis although recent studies showed that other abdominal maladies also produce increased amylatic activity of the serum

J L Abruzzo, M Homa, J C Houck and R J Coffey[3] reviewed all serum amylase determinations made at Georgetown University Hospital during 1949 56 The spectrophotometric technic was used and the accepted normal range was 40-130 units Among 977 patients in whom 1,840 determinations were done, serum amylase was abnormally high in 494 Elevation in 379 (76%) was related to pancreatic dis-

(3) Ann Surg 147 921 930 June 1958

ease In 78 patients, abnormally low amylase level was found, suggesting extensive destruction of the pancreas or advanced liver damage

Acute edematous pancreatitis was accompanied by elevation of the serum amylase in all 42 patients analyzed Elevation levels ranged between 140 and 1,800 units, with mean of 360 In patients with acute necrotic (hemorrhagic) pancreatitis, 10 of 11 showed elevated serum amylase, whereas 1 showed depressed (30 units) amylase The range of elevation was 150 1,040 units, with a mean of 570 Of 32 patients with chronic pancreatitis, 15 had elevated serum amylase at the time of admission when they had acute exacerbation The height of the elevation did not differ from that noted in patients with acute pancreatitis In 4 of the 32 patients, the serum amylase level was distinctly subnormal, suggesting destruction of the pancreatic tissue In patients with carcinoma of the pancreas only 1 of 28 revealed elevated amylase, whereas 11 showed subnormal levels

AMYLASE DETERMINATIONS IN NONPANCREATIC DISEASE

	Total Cases	Elevated	Subnormal
Parotitis	15	13	
Cholecystitis	119	21	14
Common duct obstruction	23	8	
Peptic ulcer	112	18	6
Post gastrectomy	51	21	
Intestinal obstruction	20	4	
Mesenteric thrombosis	6	2	
Peritonitis	13	9	
Cirrhosis	17		6
Renal disease	26	2	

After resection or other operative manipulations of the pancreas, serum amylase elevation was observed postoperatively in 7 of 26 patients

A considerable number of patients with nonpancreatic disease showed elevated serum amylase (table) This was not uncommon in patients with duodenal or gastrojejunal ulcers, but in gastric ulcer it was rare After gastrectomy, half of the patients showed increased serum amylase though clinical signs of acute pancreatitis were usually absent

► [This study confirms previous observations concerning the necessity for utilizing serum amylase determination as an adjunct to clinical evaluation In most instances, a thorough clinical and laboratory evaluation

will lead to the proper management of the patient In an occasional instance where the findings are highly suggestive of perforated ulcer, exploration will be necessary even though acute pancreatitis cannot be completely excluded —Ed]

Physiologic Basis for Surgical Management of Acute and Chronic Pancreatitis was derived by Henry Doubilet[4] (New York Univ.) *from observations in over 500 patients with* sphincterotomy. In most persons (about 60-80%), the bile and pancreatic ducts join to empty through a single orifice (papilla of Vater) into the duodenum. Spasm of the sphincter of Oddi, or more rarely, lodging of a stone in the papilla, can

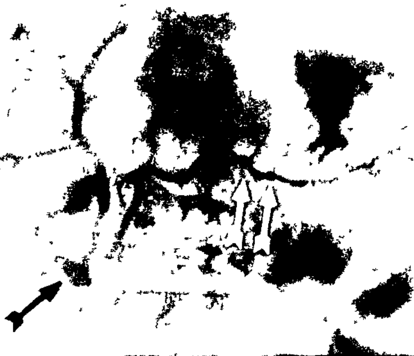


Fig 100 —Common passageway Operative cholangiogram in case pancreatitis, showing reflux to tail of pancreas and also to some of finer ducts (*white arrows*) Excessive reflux is due to diminished pancreatic secretory pressure resulting from residual acute inflammation Spasm of sphincter was produced deliberately by application of hydrochloric acid to papilla through Rehfuss tube (*black arrow*) (Courtesy of Doubilet, H S Clin North America 38 505 520, April, 1958)

convert the bile and pancreatic ducts into a common passageway, permitting bile to enter the pancreatic ducts, or conversely, allowing pancreatic juice to pass up the biliary tract (Fig. 100). Direction of flow depends on relative pressure in each duct system, which may vary from minute to minute.

The human sphincter of Oddi is a labile organ, responding readily by increase in tonus (spasm) to frustrating emo-

(4) S Clin North America 38 505 520, April, 1958

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(4) S Clin North America 38 505 520 April 1958

tional disturbance, pain in other parts of the body and exhaustion Under such conditions, if a common passageway is present, flow in an abnormal direction under stimulation of food intake occurs, producing an acute inflammatory response In typical cases of recurrent pancreatitis, the acute pain, resulting from inflammation of the peritoneum and structures surrounding the pancreas, occurs against a background of a long history of tension and pain due to disten



Fig 101 —Disappearance of pseudocyst after adequate drainage of pancreatic duct Patient alcoholic had inadequate drainage due to obstruction of duct of Wirsung by calculus Split pancreaticojejunostomy was performed interposing Roux Y *loop of jejunum between tail and body of pancreas* Note (*A*) proximal (*white arrow*) and distal (*black arrow*) portions of duct Large pseudocyst (*black arrow*) was found taking off from rupture in distal portion of pancreatic duct Two weeks later (*B*) pseudocyst had almost disappeared as result of reduction on intraductal pressure (Courtesy of Doubilet H S Clin North America 38 505 520 April 1958)

tion of the bile and pancreatic ducts behind the sphincter

Complications of acute pancreatitis include hemorrhage, jaundice, inflammation of the left kidney, pseudocyst and cyst, chronic pancreatitis reduction in secretion of pancreatic juice, calcification of the pancreas and sensitivity of the diseased pancreas to fat and alcohol Treatment aims at placing the pancreas and adjoining organs at complete rest by (1) continuous nasogastric suction (2) anticholinergic drugs, (3) antibiotics, (4) replacement of lost electrolytes and water and (5) replacement of lost albumin

Definitive treatment of recurrent pancreatitis is section of the sphincter of Oddi, with cholecystectomy, during a nonacute phase Ordinarily, sphincterotomy results in disappear-

ance of a pseudocyst, and in the presence of calcification, if the duct of Wirsung is free from stone or stricture, cure results If there is partial obstruction due to a stone in the main duct, the stone must be removed by direct incision or, if that is not feasible, a split pancreaticojejunostomy should be performed (Fig 101) This procedure is superior to caudal pancreaticojejunostomy, which involves removal of the tail of the pancreas that, in man, contains most of the islet cells

After an operation for pancreatitis, the patient must be placed on a low-fat, alcohol-free diet for at least a year and must be reassured if a setback due to dietary indiscretion occurs If the pancreas is markedly fibrosed, with the capsule so rigid that there is no room for regeneration, the dietary regimen must be maintained for many years

Acute Pancreatitis in Children. Gunnar B Stickler and Robert H Yonemoto[5] report a case of pancreatitis in a girl age 4 Review of the literature disclosed 37 other cases of acute pancreatitis in children Seven were caused by trauma, 1 by trichobezoar, 2 possibly by ascarides, 3 occurred during steroid hormone treatment, and 1 was conceivably due to mumps Etiology of the other 24 cases remained obscure

The clinical course of this disease in children, regardless of etiology, was typical, with sudden onset of abdominal pain and vomiting, all the signs of an acute abdomen, marked leukocytosis and elevated serum amylase levels At surgery, blood stained peritoneal fluid, multiple fat necroses and enlargement and edema of the pancreas were found

Only 2 deaths in children have been reported since 1932 Maintenance of adequate fluid and electrolyte balance may be important in postoperative treatment Therapy of pancreatitis in adults seems to be applicable to the disease in children including gastric suction and administration of atropine or propantheline to suppress reflex secretion of pancreatic juice Adequate sedation and possibly administration of antibiotics are also standard treatment

Awareness that acute pancreatitis may occur in children should prompt more frequent serum amylase determinations in children with acute abdominal findings This might help to prevent occasional unnecessary laparotomies, especially after abdominal trauma

► [One type of pancreatitis in children not mentioned by the authors is

(5) A M A J Dis Child 95 706-713 February 1958

that which occurs in association with hyperlipemia The exact relationship of the hyperlipemia to pancreatitis is not understood, but the simultaneous occurrence of these diseases indicates that the two processes are in some way related —Ed]

Choledochojejunostomy Its Successful Use in Treatment of Persistent Acute Pancreatitis According to Ralph F Bowers and George A Riley[6] (VA Med Teaching Group Hosp, Memphis, Tenn), surgery is not necessary in the average case of acute pancreatitis When diagnosis is established, gastrointestinal drainage, antibiotics, intravenous calcium, blood, blood substitutes or other indicated shock therapy and an occasional procaine block of the thoracic sympathetic chain prove satisfactory From 1947 to 1957, 34 patients were treated for acute pancreatitis, with 1 death (2 9%) All but 6 were treated medically, 5 were operated on during the acute stage

Simple laparotomy with closure but no definitive surgical therapy was done in 3 One had cholecystectomy for cholelithiasis and chronic cholecystitis, and death was probably due to low-grade pancreatitis, unrecognized by the surgeon at operation

Experience with 2 patients with persistent acute pancreatitis suggests that the conservative approach must occasionally be abandoned in favor of operation Both failed to respond to medical measures In 1, a man aged 36, a sleeve resection of the stomach was done, on the incorrect assumption that aberrant pancreatic tissue in the posterior wall of the stomach was the cause of persistent infection Simple drainage of the abscess in the stomach wall and cholecystostomy would probably have been better The patient survived operation without serious deleterious effect but was not improved Hence choledochojejunostomy en Roux Y was performed a month after the stomach resection and produced definite improvement, which was maintained for almost 2 years despite heavy intake of alcohol Original weight gain was 43 lb, but 22 lb was lost after resumption of heavy drinking

In the other, a male alcoholic aged 33, medical therapy for acute pancreatitis produced almost no improvement Ascites continued to recur, and the general condition deteriorated Cholecystectomy and common duct drainage by T tube relieved symptoms for about 6 months, when typical

(6) Ann Surg 148 259 765 August 1958

pancreatic pain, nausea, vomiting and anorexia returned. Improvement was marked, but recovery was not complete. The patient was no longer acutely ill but some symptoms of pancreatitis recurred periodically, with loss of weight, especially after heavy bouts of drinking. X-ray suggested the presence of a pseudocyst which may be responsible for gastrointestinal symptoms.

A few patients who have mild attacks of pancreatitis for an indefinite time after choledochojejunostomy sometimes subsequently show satisfactory control of attacks. One patient, reported as a failure in an earlier report, had not had an attack for 26 months and was in good health.

Perhaps choledochojejunostomy or external drainage or biliary tract corrective surgery can be compared with gastroenterostomy for peptic ulcer, where the ulcer diathesis persists but is controlled by lowering of acid. In chronic pancreatitis, control of attacks was achieved in 88% of the patients (22 of 25).

Technic of Pancreatojejunostomy after Left Pancreatectomy for Chronic Pancreatitis is described by Lucien Leger[7] (Paris).

TECHNIC.—Left costosupraumbilical or transverse abdominal incision may be used. Most often median supraumbilical incision is extended below the umbilicus to obtain sufficient exposure. If information obtained by direct examination, biopsy and, when possible, pancreatography by puncture indicates that operation should be continued, the gastrocolic mesentery is opened between a double row of ligatures. Opening of the posterior cavity from right to left leads to the hilus of the spleen. Gastrosplenic mesentery and short vessels are sectioned. The spleen is often enlarged, but not adherent and its mobilization causes little bleeding. Exteriorization of the spleen leads toward the right to the posterior surface of the tail of the pancreas and permits the beginning of freeing of the body of the pancreas from the posterior wall. The operation is greatly facilitated by splenectomy. The tail of the pancreas is removed with the spleen. The practically bloodless resection removes en bloc the tail, body of the pancreas, splenic artery and vein. Dissection is always carried toward the right to near the midline but not beyond. Confluence of the inferior mesenteric vein and the splenic vein, situated slightly to the left of the midline, furnishes a good landmark. The splenic artery and vein are isolated from the posterior surface of the pancreatic isthmus near the midline.

After marking the superior and inferior borders of the isthmus, it is sectioned vertically. The scalpel encounters some arterioles that must be ligated and also in case of lithiasis, some crunching of small

(7) J. chir. 76: 93-115, June-July, 1958.

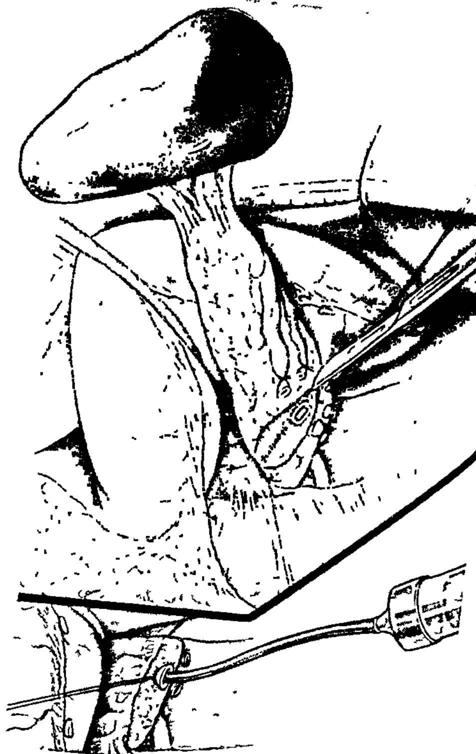


Fig 102 Section of pancreatic isthmus between previously sectioned splenic ves-
sels Isthmus is approached by its posterior surface immediately above anastomosis
splenic vein and inferior mesenteric vein at curved retractor Wirsung's canal
ably dilated appears in section of isthmus *Inset* after total section of isthmus of
creas dilated Wirsung's canal is catheterized with polyethylene tube and pacified
injection of organoiodide contrast medium for retrograde pancreatography (Cour
of Leger L J chir 69 3115 June July 1958)

stones (Fig 102). The pancreatic duct is sectioned; this is often dilated, containing pancreatic juice that escapes through the incision Dilatation of Wirsung's canal is definite indication for pancreatojejunostomy, but ectasia is not always evident and sometimes requires investigation and later operation If pancreatojejunostomy is not indicated, the pancreatic wound is sutured and left pancreatectomy is completed

End-to-end anastomosis of the jejunal loop to the cut pancreas is

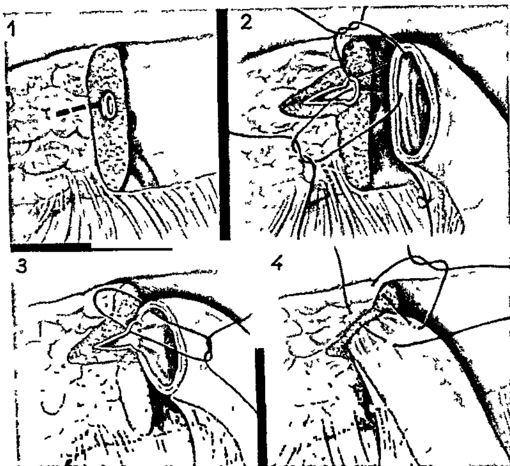


Fig 103 —When Wirsung's duct is slightly dilated anterior splitting incision (*1*) permits better mucomucosal approximation of Wirsung's canal and of jejunal loop (*2* and *3*) Some seroserous points complete connection (*4*) (Courtesy of Leger, L J chir 76 93 115, June-July, 1958)

carried out in two planes, achieving, if possible, approximation of the mucosa of Wirsung's canal to the jejunal mucosa, which often is difficult Approximation of the mucosas of the pancreatic duct and jejunum is more difficult when the principal pancreatic duct is of the caliber of the small finger, which is common In some instances, the mucosas are merely brought together by four sutures passed through four cardinal points and knotted later The mucomucosal connection, when not watertight, is reinforced by a circular plane solidifying the jejunal serosa to the pancreatic capsule at separate points When the diameter of Wirsung's canal is small, attempt is made to increase

the caliber by a splitting incision of about 1 cm to the anterior wall of the gland transforming in a sort of Y the circular section of the canal (Fig 103)

Such incision is often necessary in exploring for calculi and for

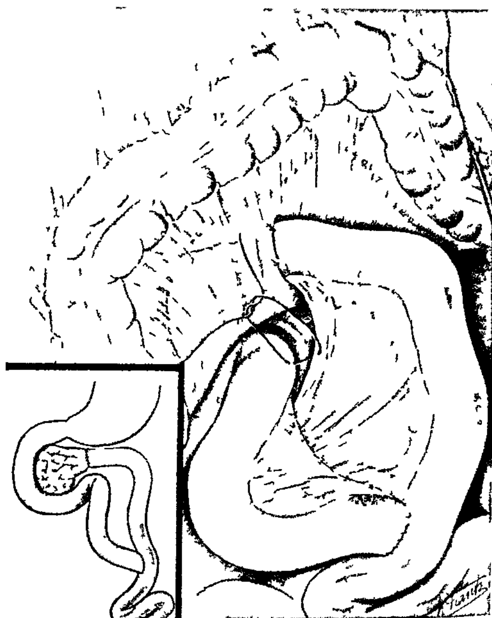


Fig 104—In submesocolic layer intestinal continuity is reestablished by end-to-side anastomosis of upper end of jejunum with foot of intestinal loop anastomosed in supramesocolic region Careful suture of mesentery *Inset* diagram of Y anastomosis (Courtesy of Leger L J chir 76 93 115 June July 1958)

dredging the cephalic segment of Wirsung s duct it is later used to enlarge the caliber of the anastomosis This anterior splitting incision also has the advantage of opening the cephalic segment of the dilated Wirsung s canal when the isthmic section is of normal

caliber If Wirsung's duct is more or less dilated, pancreatojejunostomy is performed Anastomosis of the entire parenchyma to the jejunal loop is made in two planes, at separate points The diseased sclerotic pancreas resists well traction of sutures and does not fragment, contrary to what might be expected, thus firm, secure anastomosis is accomplished

After the anastomosis is completed, the lips of the transverse meso colon are fixed to the jejunal loop that traverses it In the submesocolic layer, the edge of the mesentery of the anastomosed loop is sutured to the posterior parietal peritoneum to the left of the duodenal-jejunal angle to avoid all risk of occlusion The upper end of the jejunum is anastomosed to the main intestinal loop, 20 cm below the transverse mesocolon This anastomosis will be end to side, in two planes The edge of the free mesentery of the first jejunal loop is sutured to the right leaf of the peritoneum of the intestinal loop in contact with the pancreas Thus anastomosis in the Y is completed (Fig 104) A Penrose drain is left in contact with the anastomosis

► [Leger advocates resection of more pancreatic tissue than most American surgeons would excise Because of the possibility of diabetes and pancreatic insufficiency in ... xcisions of large portions of the body a ... ed, unless in so doing one can remove ... the fact that the main portion of the di ... gland resection of the body and tail eradicates the disease in only an occasional patient —Ed]

Appraisal of Surgical Procedures for Pancreatic Pseudocyst It is generally held that pseudocysts of the pancreas require surgery W Dean Warren, William H Marsh and William R Sandusky[8] (Univ of Virginia) review this problem from three sources 12 patients treated at the University Hospital, observation on experimental production and internal decompression of pancreatic pseudocysts in dogs, and the literature on this subject since 1945

Of the 12 patients, 8 had external drainage Pseudocyst recurred in 2 patients, 1 of whom had 2 recurrences In 3 patients the primary operation was internal decompression, and in 1, laparotomy and aspiration, with excellent results None died

Experimental pseudocysts were produced in 26 dogs Half were treated by transgastric cystogastrostomy and the others by cystojejunostomy defunctionalized in the manner of Roux Postoperatively, 3 dogs died in the former group and 4 in the latter Obliteration of the cyst was slow (6-12 weeks), but it was complete in all of the surviving dogs The postoperative course varied little between the two methods of treatment

(8) Ann Surg 147 903 9?0 June 1958

Review of 481 cases in the literature (table) shows the most successful procedures for pancreatic pseudocyst In theory, total excision of a pancreatic pseudocyst is an ideal operation, but in practice it is only applicable to small cysts in the distal pancreas unattached to distal structures Ex ternal drainage is simple, but the high rate of recurrence and mortality limit its use to patients who cannot tolerate more extensive surgery

SUMMARY OF RESULTS FROM COLLECTED SERIES

Operation	Number	Reoperation	Mortality
External drainage	225	24 4%	3 1%*
Extirpation	48	6 3%	12 5%
Cystojejunostomy			
Simple loop	32	6 3%	15 6%
With jejunojejunostomy	8	37 5%	0
Roux-en Y	46	4 3%	2 2%
Cystogastrostomy	107	4 7%	2 8%
Cystoduodenostomy	15	20 0%	6 7%

*Adjusted from 4 9%

Surgical Treatment of Cystic and Pseudocystic Formations of Pancreas.—I Results and indications for surgical treatment of pseudocysts of pancreas.—It is difficult to evaluate precisely various methods of treatment of pseudocysts of the pancreas because substantial statistics are not available many reports are of single cases or small series and they do not show late results Traumatic and postnecrotic pseudocysts are essentially different one develops in a healthy pancreas and the other in an organ already diseased with lesions varying in degree and progression After collecting data on 561 (27 personal) cases P Mallet Guy[9] (Lyons) arrived at some useful conclusions as to therapeutic indications

External drainage presents no immediate or future danger if satisfactorily performed and observed It effects definitive cure in about 40% of the patients and always improves the local and general condition Development of pseudocyst may be followed by successive x ray examinations which after drainage along with the curve of pancreatic secretion indicates approaching cure

Anastomoses are definitely better but results are good

(9) Presse med 66 1621 1622 Oct 18 1958

only in about two thirds of the patients Sometimes the patient's condition is aggravated, and anastomoses have no effect on the causal disease They have only palliative value, without always offering certain advantages found with external drainage

Pancreatectomy assures complete treatment, but demands conditions not always realized Pancreatectomy can be preceded by external drainage, but when the lesions are located in the head, this is seldom possible Sphincterotomy with transcystic drainage is not curative It has the inconveniences, but not all the advantages of technics of anastomosis

II Methods and indications for treatment of cystic and pseudocystic formations of pancreas—M Mercadier[1] (Paris) emphasizes that cysts and pseudocysts of the pancreas always present complex therapeutic problems because of their diverse pathogeneses and morphologic variety

True cysts are cystic neoplasms, with fluid content limited by an autonomous, continuous wall They arise from pancreatic parenchyma, supporting connective tissue or vascular elements They may also develop from heterotopic elements more or less differentiated, included in the pancreas during early stages of its development Neoplastic cysts of acinose or excretory origin and dermoid cysts are relatively common

Pseudocysts are not tumors, but collections of fluid secondarily encysted, containing more or less active pancreatic juice, altered blood and products of autolysis of the glandular parenchyma They are determined by the necrotizing effect of pancreatic enzymes on the pancreas and neighboring organs Pseudocysts trace their origin to extravasation and simultaneous activation of pancreatic juice after the duct is broken open by traumatic rupture, vascular accidents or extreme distention because of retention of pancreatic fluid Necrosis is the common result and gives to pancreatic cysts their specific aspect Major necrosis is incompatible with life but limited lesions lead to cyst formation Cystic accumulations may communicate with the excretory system When the pseudocyst has no connection with collecting vessels of the gland the cyst, intraparenchymatous or extrapancreatic cannot be enlarged by pancreatic secretion and cannot be drained by the duct system Thus excluded, it re-

(1) Presse méd 66 1622 1624 Oct 18 1958

mains stationary or presents the same risk of progression as any intraperitoneal collection of fluid

There are multiple methods for treating cysts and pseudo cysts of the pancreas, which, in principle, depend on drainage or removal Drainage methods include marsupialization, external drainage, transduodenal cystoduodenostomy and cystogastrostomy. Removal methods include enucleation for well-circumscribed cysts, removal of the cyst and surrounding parenchyma, partial pancreatectomy for left-sided lesions and upper pancreatectomy for necrotic pseudocysts with persistence of a healthy pancreatic segment above the cyst and permeable ducts below Cysts of the head or isthmus are managed by duodenopancreatectomy

Most congenital cystic malformations of the pancreas are not amenable to surgery, but most dermoid cysts can be excised Neoplastic cysts should be resected when possible, especially if malignant degeneration is suspected or anticipated Hydatid cysts of the pancreas represent true glandular tumor, comparable to neoplastic cyst, and have to be dealt with according to their size, morphology and location Choice of treatment method in retention of pseudocysts is determined by the anatomic character of the lesion

Clinical and Surgical Aspects of Pancreatic Pseudocyst Analysis of 58 Cases is presented by John M Waugh and Thomas E Lynn[2] (Mayo Clinic and Found) Pseudocyst of the pancreas commonly occurs as a complication of pancreatitis but may develop after abdominal trauma Characteristically, a patient with a cyst of this type has a history suggestive of recurring pancreatitis and has a palpable mass somewhere in the upper part of the abdomen Occasionally, obstruction of the upper portion of the intestinal tract is the most prominent clinical feature X rays may show abnormalities in the stomach or intestine caused by pressure from the cyst

The optimal operative approach to a suspected cyst of the pancreas depends largely on the size and location of the mass and on coexisting pathologic changes in other organs A transverse incision over the pancreas affords best exposure of the entire gland Most commonly, a pancreatic pseudocyst is explored through an opening in the gastrohepatic or gastrocolic omentum

(2) A M A Arch Surg 77 47 54 July 1958

Among 58 patients, incision and drainage was used in 23, incision and marsupialization in 17, complete excision of the cyst in 9, internal drainage in 8 and evacuation of the cyst in 2 One patient with 2 cysts had incision and drainage of 1 and excision of the other

External drainage of the pseudocyst gives satisfactory results if such drainage is adequate and maintained sufficiently long Recurrent cysts developed at the same site in 2 of 40 patients in this series Optimal duration of drainage depends on the size of the cyst and the rapidity with which the cavity is obliterated The drainage tube should be repositioned regularly to obviate the chance of erosion through the cyst wall Although generally a pseudocyst is considered not to have a direct connection with the duct system of the pancreas, occasionally after operation drainage contains some external pancreatic secretion Then prolonged drainage or possibly some subsequent surgical procedure, such as internal drainage may be required before final healing occurs

Total extirpation of the cyst gives excellent results, but is seldom feasible, because of adherence of the cyst to surrounding structures and to the pancreas itself Internal drainage may be preferred in selected cases Its more frequent use in recent years will allow its more critical evaluation in the future

Choice of Surgical Procedures in Treatment of Pancreatic Cysts in 120 patients, aged 11 months to 74 years, is described by Kenneth W Warren and Augustus L Baker, Jr[3] The types of cyst were cystadenoma 2, cystadenocarcinoma 9, secondary to malignant tumor 7, angiocyst 1, retention cyst 35, retention cyst in aberrant pancreas 1 and pseudocyst 65 (57 postinflammatory) Almost every conceivable operation was used in the treatment of these cysts There were but 2 postoperative hospital deaths, both patients had chronic relapsing pancreatitis

Preferred treatment is removal by excision or resection, but this cannot be achieved in many instances because many pancreatic cysts are of traumatic or inflammatory origin In some instances, the patients may be too ill to allow definitive treatment, even though the local condition would warrant a radical approach Hence, considerable judgment must be exercised in the choice of surgical maneuver Available pro-

(3) S Clin North America 38 815 879 June 1958

cedures include simple drainage, marsupialization, internal drainage, excision and resection

The incision generally used is vertical, through the left upper rectus area or the linea alba. If the patient is seriously ill, it is best to approach the cyst in whatever position the anterior surface is presented because simple drainage probably is indicated. If the patient's general condition is good, the cyst should be dissected sufficiently to determine whether it can be excised.

Simple drainage, using a de Pezzer catheter, is highly ef-

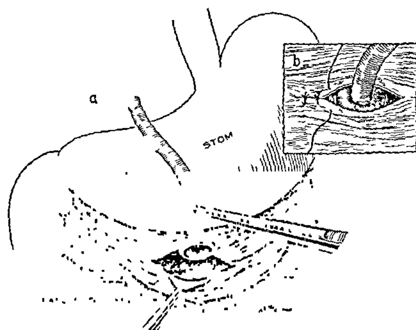


Fig 105 —Cyst is incised sufficiently to permit complete evacuation of contents and inspection of lining of cavity Flanged end of de Pezzer catheter is sutured into cyst and other end brought out through stab wound (Courtesy of Warren, K W, and Baker, A L, Jr S Clin North America 38 815 829, June, 1958)

fective (Fig 105). It has the advantage over marsupialization in that the catheter can be left in the cystic cavity and pancreatic secretions can be directed into a plastic flask so that skin irritation is obviated This method is particularly applicable to cysts deeply situated in the head or uncinate process. Cysts in this location are not easily treated by internal drainage.

Internal drainage was rarely used in this series A transgastric approach may be used when the cyst adheres to the posterior wall of the stomach (Fig 106) This procedure should not be the preferred method except for inoperable

cystadenocarcinoma Internal drainage may be selected in recurrent retention cysts when complete excision appears unduly hazardous Despite its limited use, 1 patient had a massive gastrointestinal hemorrhage a few days after discharge following cystojejunostomy Four patients were referred because of recurrent pancreatic cysts after preliminary cystoduodenostomy or cystojejunostomy

Some of the largest cysts are most susceptible to total excision by enucleation because these retention cysts are usually devoid of pancreatitis or peripancreatitis Cysts confined

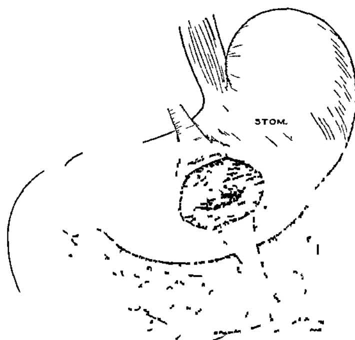


Fig 106 —Retrogastric cyst adhering to posterior wall of stomach may be drained by incising anterior wall of stomach opening cyst where it adheres to posterior gastric wall and suturing opening thus made between cyst and stomach with continuous suture of chromic catgut Anterior gastrotomy is then closed (Courtesy of Warren K W and Baker, A L Jr S Clin North America 38 815 829 June 1958)

to the tail and body of the pancreas, unless associated with severe pancreatitis, are preferably managed by distal pancreatectomy This procedure is facilitated by removing the spleen, which is mobilized in continuity with the tail and body of the gland Recurrent cysts of traumatic origin are especially susceptible to distal pancreatectomy because they are associated with complete obstruction of the duct of Wirsung at the point of transection of the gland Neoplastic cysts confined to the body or tail should also be treated by distal pancreatectomy

an attempt was made in the operating room to screen out hopeless cases for simple palliative procedures, while persisting with radical efforts in more promising situations Biopsy of operable lesions in the pancreas was discontinued Criterion of operability has been demonstration of metastases outside the limits of the proposed resection

During the radical and rational periods, 18 4% of 260 cases explored were considered operable Operability of carcinoma of the ampulla of Vater fell only from 70 to 66 6% in the second period In all other types, operability fell from 21 1 to 6 8% Owing to anatomy, ampullary growths produce early jaundice and thus arrive in the operating room earlier They may also be less prone to early spread

Among 47 operations, 8 postoperative deaths occurred (table) *According to present opinion, 3 of these cases would*

OPERATIVE MORTALITY

TYPE OF OPERATION	NO CASES	NO DEATHS	% OPERATIVE MORTALITY
Total pancreatectomy	18	5	27 7
Partial (head) pancreatectomy*	27	3	11 1
Local excision (duodenal carcinoma)	2	0	
	1	0	
			16 6

be clearly inoperable, in 2 patients, the portal vein was invaded, and 1 had ascites Hence, a lower mortality rate can be expected in the future Operative mortality for all cases from 1948 to 1952 was 15 6%, from 1953 to 1957, 13 3%, and from 1948 to 1957, 16 6% If the 8 patients who died postoperatively, 1 with no malignancy and those still living are excluded, the others lived an average of 19½ months postoperatively *before dying of metastases*

Among 18 total pancreatectomies, 5 postoperative deaths (27 7%) occurred, including 2 patients who would now be considered to have inoperable conditions *Mortality for* resections of the duodenum and head of the pancreas (27 patients, 3 deaths) is 11 1% Excluding 1 inoperable case in this category suggests an operative mortality of about 7 7% in the future Of 128 patients operated on in the first 5 years, 6 (4 7%) became "5-year cures" One of these died of metastases after 8 years Of 130 with resection during the second 5 years, 10 were living

The postoperative course tients who su al

pancreatectomy for carcinoma and of a few who were operated on for pancreaticolithiasis, was most satisfactory In general, they have behaved like patients with mild diabetes with partial gastrectomy Four with pancreatectomies had major hemorrhages from marginal ulcers, 3 of these patients are included in the present series The other antedates this series and was in the 11th postoperative year after partial pancreatectomy (head) for carcinoma of the ampulla of Vater Two of the 4 had total pancreatectomy, and 2 had resection of the duodenum and head of the pancreas Since in pancreatectomy the major source of alkali in the gastrointestinal tract is removed, it has become standard practice to remove at least 50% of the stomach

Three patients with partial pancreatectomy, who showed sprue and/or diabetes after reasonably long intervals postoperatively—presumably due to stricture of the pancreaticojejunostomy—were being well maintained on appropriate substitution therapy Significance of the "late syndrome" is that it may, if demonstrated and properly treated, result in a normal life for patients who otherwise might be considered as being on a downhill course due to metastases

In this 10 year experience, the primary problem was finding the middle road between futile radical surgery, with its high operative mortality, and surgical timidity, with its loss of patients to disease The goal is to do a very radical operation on each patient with curable disease and to do the simplest palliative procedure if the disease is not curable

► [This excellent study by Porter demonstrates well the failure of total pancreatectomy to solve the problem of treatment of pancreatic carcinoma and indicates, as do other studies, that the more extensive operation adds very little to the treatment of disease as compared to subtotal pancreatoduodenectomy which can be accomplished with a lower mortality rate and less postoperative morbidity since diabetes is not created.—Ed]

Study of Interstitial Radiation of Dog's Pancreas with Radioactive Colloidal Gold (Au^{198}) Preliminary to Use in Malignant Diseases of Pancreas Current treatment methods for carcinoma of the pancreas are not adequate and in many instances cannot be used because of the advanced stage of the disease Roughly 25% are inoperable, 50% are operable but not resectable, and only 25% or less are resectable Probably only 5-10% of these are curable, at best Surgery is currently not the answer, whether it is for cure or palliation by control of the tumor

Richard J Ireton and Robert N Watman[6] (Ohio State Univ) evaluated experimentally the use of radioactive colloidal gold in the pancreas They developed a satisfactory method of injection at time of exploratory laparotomy The radiation hazard involved in injecting the radioactive gold into the experimental animal and in care of the animal after injection was minimal and well within the maximum safe weekly allowance Despite injection of the radioactive gold into a gland with an excretory duct, there was no loss of radioactivity in the feces or urine Thus, the total activity remained in the animal, enabling dosage to be calculated, and there was no increase in the radiation hazard

Acute pancreatitis was not caused by surgery or the actual injection of the radioactive gold in any of the experimental animals as demonstrated by daily serum amylase levels clinical evaluation and autopsy examination The injected radioactive colloidal gold was found to remain at the injection site and in the neighboring mesentery and retroperitoneal tissues and did not spread to the liver, spleen or other adjacent organs The radioactive colloidal gold destroyed the pancreas almost totally at the injection site, but caused no demonstrable effect on the rest of the pancreas

Operative Experience with Carcinoma of Body and Tail of Pancreas Charles E Kibler and Philip E Bernatz[7] state that only minimal progress toward early diagnosis and successful treatment of carcinoma of the pancreas has been made in more than a century since its description Of 175 primary carcinomas of the body and tail of the pancreas observed during 1920 56, 158 were adenocarcinomas, 6 papillary cystadenocarcinomas and 11 malignant islet lesions This series comprises 18% of all malignant lesions of the pancreas that came to operation

Outlook for patients with adenocarcinoma of the body and tail of the pancreas is summarized by the word "dismal" Among 7 patients in whom the lesion was completely removed the longest survivor had recurrent carcinoma 2 years after pancreaticoduodenectomy Two of the 7 died in the immediate postoperative period None of 34 patients operated on within 3 months of onset of symptoms survived a reasonable length of time

(6) Surgery 45 475 486 March 1959
(7) Proc Staff Meet Mayo Clin 33 247 255 May 14 1958

Earlier diagnosis should result in some curative resections Pain is usually the initial symptom, but clinical results indicate that onset must precede symptoms by an unfortunate period Peripheral venous thrombosis was present as the initial sign in only 1 patient Phlebitis was present at some time in 6% of the entire group but was a late sign, associated with extensive spread of cancer and usually metastasis to the liver Upper abdominal pain and weight loss in the absence of abnormal physical or laboratory findings make up a characteristic early clinical picture X-ray signs often reflect late stages Repeated unsuccessful efforts of physicians to demonstrate objectively the reason for pain in these patients have often led to a diagnosis of psychoneurosis The patient's reaction of anxiety and depression has apparently justified psychiatric consultation Diagnosis of cancer of the body and tail of the pancreas can be made with certainty only at operation Exploration should be used earlier on the basis of the clinical picture, rather than delayed until objective evidence becomes available The futility of the latter course is certain

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THE ESOPHAGUS

Congenital Esophageal Atresia and Tracheoesophageal Fistula: Review of 36 Patients is presented by K D Roberts[8] (Children's Hosp , Birmingham, England) The essential feature of total esophageal obstruction in the newborn is inability to swallow saliva, so that a characteristic fine frothy mucus is continually produced in the mouth, unlike the rather coarse bubbles often found for a time after birth Signs of respiratory obstruction with stridor may be due to a fold of mucous membrane in the trachea at the site of the fistula

When esophageal atresia is suspected, an attempt should be made to demonstrate this by introducing an esophageal catheter which can be passed no farther than 10 12 cm from the alveolar margin Radiologic examination should begin with fluoroscopy in anteroposterior and lateral views to evaluate the state of the lungs and note the appearance of the

(8) Thorax 13 116 129 June, 1958

stomach and small bowel Contrast studies consist of introducing a soft rubber catheter into the esophagus under radiologic control, the catheter having first been filled with iodized oil When the catheter is just in the esophagus, a few drops of oil are injected These outline the rounded termination of the esophageal pouch at the level of the 2d to 4th thoracic vertebrae This blind pouch shows up and down excursion with respiratory movement Radiographs are taken and the catheter is withdrawn after aspiration of all the oil from the esophageal pouch

Whenever possible, a primary esophageal anastomosis was done When tension was too great or other factors contraindicated anastomosis the first stage of a staged procedure was done i e, closure of the fistula left cervical esophagostomy and Stamm gastrostomy Mortality was 50% Preoperative evidence of aspiration of mucus into the bronchial tree was proved radiologically in 16 patients, the commonest site being the right upper lobe

Some narrowing of the esophageal anastomosis is common after a primary anastomosis for atresia Significant stenosis leads to difficulties in feeding and, more important to overspill of oral secretions into the bronchial tree Strictures may be early, developing within 6 weeks of the anastomosis or late, occurring over 6 months after surgery or persisting from the early stage Early strictures were found in 9 infants and late in 3 Tension effects after primary anastomosis may be due to leakage of air from the trachea or breakdown of the esophageal anastomosis A tracheal leak occurred in 1 infant and esophageal leakage in 2 after primary anastomosis

Whenever possible, primary esophageal anastomosis should be done for esophageal atresia When tension is too great to allow a safe anastomosis a staged procedure should be done When colon esophagoplasty is done, special care is necessary in postoperative management The 3 colon grafts in the series failed

► [Esophageal stricture following operation in these cases may be controlled by carefully performed periodic bougienage reserving corrective operations for the uncommon case that is refractory to treatment If surgical repair later becomes necessary the child will have attained sufficient size to enhance the success of the procedure —Ed]

Operative Treatment of Atresia of Esophagus Results and Complications are reported by Tyge Cl Gertz and C C

Winkel Smith[9] (Univ of Copenhagen) Of 67 newborn infants hospitalized for atresia of the esophagus, 39 died—a total mortality of 58% for both operated and unoperated infants

In the commonest form of atresia of the esophagus, the upper segment ends blindly, and the lower segment is united by fistula to the trachea slightly above the bifurcation This type, the most amenable to operation, was present in 90% of the patients In 8 patients, no surgery or only palliative gastrostomy was done owing to poor general condition In 6 patients, surgery could not be completed The anastomosis had to be abandoned because of too large diastasis and cutting-through of the sutures

Radical operation was done in 52, with a mortality rate of 46% Of the 28 survivors, 3 died later, and the others thrived on the whole In all patients, radical operation in one session was attempted

Birth weight and age at surgery did not appear to have any decisive effect on the prognosis The commonest causes of death were related to the operative technic, followed by pulmonary complications and malformations of the heart Recurrence of the esophagotracheal fistula was seen in 9 patients, 6 of the 9 had reoperation and 4 died after the operation Among the surviving patients, stricture of the esophagus occurred in several, but in practically all it disappeared after dilatation

► [Despite the high mortality, a large part of which is due to uncontrollable factors, the gratifying fact remains that approximately half the patients who otherwise would have died were restored to normal by operation Experience would suggest that an aggressive surgical approach directed toward primary repair with precise technic gives the best results —Ed]

Mucosal Folds at Cardia as Component of Gastroesophageal Closing Mechanism were studied by G S Muller Botha[1] (Univ of Birmingham) in anatomic, physiologic and radiologic experiments Specimens were examined from 30 adults (aged 18-80) and 115 infants and children, of both sexes, who died of causes unassociated with the cardial region No conspicuous mucosal folds were found in the first 10 dissections, but in the 11th preparation a perfect watertight mucosal seal was found at the cardia (Fig 107) A

(9) Danish M Bull 5 18 25 January 1958
(1) Brit J Surg 45 569 580 May 1958

slightly oblique linear slit, 14 mm long, extending from behind forwards and to the left, represented the cardial orifice This was "opened" carefully, and two well defined mucosal lips in close apposition could be clearly differentiated (Fig 108) These were of about the same size and resembled somewhat the mitral valve Each fold was round and almost rolled or padlike at the edge They projected firmly into the esophageal lumen, as if they had been maintained in position by ac



Fig 107 (left) —Cardial orifice appears as linear slit with tightly apposed mucosal lips (elderly woman)
Fig 108 (right) —Watertight seal is open Definite ridge is present on either side (Courtesy of Botha G S M Brit J Surg 45 569 580 May 1958)

tive tone during life Immediately above these folds a slight widening occurred—the potential space of the vestibule Another arrangement was found in another specimen but in most adult specimens no extraordinary folds were seen although marked variation occurred

On the assumption that special folds are present during life that rapidly disappear after death, the gastroesophageal junction was examined in 12 patients at operation by careful palpation There was evidence of occluding mucosal folds at the cardia in every patient, although no two presented the same pattern In 2 the apposition was so perfect that the cardial orifice was located only after some search In most the orifice existed as a dimple on the lesser gastric curve The lower esophagus immediately above the cardia felt "closed to the approaching finger tip This posi

tive "gripping" tone was slight, but undeniably present and unrelated to extrinsic structures In a few patients it appeared to be wide open, although voluminous folds of mucosa were easily palpable The cardia on these occasions was flabby, patulous and apparently without tone On the greater curve there was often a baggy crescentic fold that hung on the orifice like a curtain A constant feature on the lesser curve side of the cardia was a cushion-like resistance that could easily be detected by the moving finger over an area of 5-10 mm Externally the stomach revealed no groove or constriction at this site In 1 patient the mucosal orifice was small and tight and, although it admitted only one finger, it was soft, freely mobile and could be stretched

Various types of folds were seen in animals immediately after death, but there was no evidence of these after a few hours Functional activity of these folds was proved by direct examination of the gastroesophageal junction in anesthetized animals The folds appeared to have active independent tone, which could only have been due to a well-developed muscularis mucosae, as was proved histologically

Mucosal folds at the gastroesophageal junction are actively drawn together by the internal esophageal sphincter to produce a watertight seal at the cardia These two factors —folds and sphincter—act together in perfectly balanced harmony to form the closing mechanism between stomach and esophagus The diaphragm is an important accessory mechanism and maintains the normal position of the gastroesophageal segment, so that the closing mechanism can act with the greatest advantage The angle is an organ characteristic which, as such, plays no part in the closing mechanism A mechanical valve does not exist The importance attached to the valve effect of the cardial angle is mainly derived from manometric studies on the cadaver, or even worse, on isolated gastric organs Nothing but mechanical properties could be displayed by these dead and atonic sacs The gastroesophageal junction is a dynamic living mechanism which is continuously influenced by peristalsis, posture, respiration, pulsation and stomach fullness, to name but a few of the many controllable and uncontrollable factors The structure and function of the cardia show wide variation

Valve Mechanism to Prevent Gastroesophageal Reflux and Esophagitis was investigated in dogs by Richard H

Adler, Constante N Firme and John M Lanigan[2] (Buffalo)

TECHNIC —After the diaphragm and crus were completely divided down to the esophagus, the proximal stomach and distal esophagus were freed so the cardioesophageal junction and fundus could be moved into the left chest Reflux was determined by filling the stomach from the pyloric end with sterile saline, exerting manual pressure on the middle of the stomach, observing the shape of the distal esophagus and carefully noting intragastric and intraesophageal pressures simultaneously

For controls, the cardioesophageal junction was placed above the diaphragm, simulating a hiatal hernia, and checked for competence This was done in most dogs before constructing the angle or valve 2 were left in this position for further study In 6 dogs the cardioesophageal angle was reconstructed above the diaphragm by approximating the fundus to the left esophageal border with a row of interrupted sutures for 4-8 cm from the cardioesophageal junction With the angle reconstructed, the next group of dogs had the distal esophagus buried in a tunnel of fundus 2 4 cm long and loose enough for one finger to be easily inserted under the tunnel along the esophagus Another group had a sling of nylon net placed around the distal esophagus onto the stomach after the esophagogastric angle was reconstructed The net in contact with the distal esophagus was about 3 cm wide It was held in position on the right esophageal border by two sutures but was left loose enough for one finger to be inserted along either side of the esophagus and fundus when the stomach was not fully distended In about half the animals, the distal esophagus and proximal stomach were resected after which a standard 2 layer esophagogastric anastomosis was done before the angle was reconstructed and a fundus or sling tunnel was made Animals with esophagogastric anastomosis had concomitant pyloromyotomy In 2 dogs the entire left hemidiaphragm and crus were excised and replaced by a sheet of knotted nylon net

Only 1 of 6 dogs with only the esophagogastric angle reconstructed (Fig 109) showed competence on esophagoscopy and fluoroscopy When the specimen was removed from the body and the right esophageal border no longer maintained against a fixed surface, gastroesophageal reflux occurred

The esophagoscope dropped readily into the stomachs of dogs with hiatal hernias and reconstructed esophagogastric angles In those with fundus tunnels sling tunnels and nylon crura, compression and slight to moderate resistance were noted in the distal esophagus With a little pressure, the esophagoscope popped through this area into the stomach and was occasionally followed by escape of gas or fluid if the stomach was full All fundus and sling tunnels were compe-

(2) Surgery 44 63 76 July 1958

tent on barium studies whereas hiatal hernias and reconstructed angles had reflux except in 1 dog

Despite absence of an anatomic sphincter in the distal esophagus, the initial resistance to reflux noted at times in the surgically created hiatal hernias suggests the presence of a functional sphincter Unfortunately, it cannot prevent gastroesophageal reflux from increased abdominal pressure by itself Maintaining the gastroesophageal angle alone does not necessarily prevent reflux When, in addition, the normal distal esophagus remains properly buttressed by the

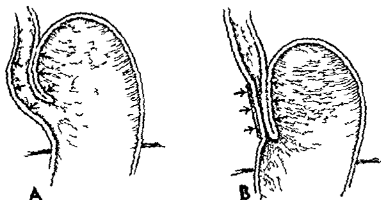


Fig 109 Reconstructed angle alone Bulging right border of distal esophagus (A) prevents competence unless properly buttressed (B) (Courtesy of Adler R H et al Surgery 44 63 76 July 1958)

crural tunnel and liver, competence results When the cardioesophageal junction is above the diaphragm, a reconstructed angle does not prevent reflux unless the opposite right esophageal border is positioned against a nonyielding surface

Recreation of the esophagogastric angle and establishment of an oblique channel for the distal esophagus afford a simple method for maintaining gastroesophageal continuity without reflux that should be suitable for the frail poor risk patient The procedure may also be applied when the cardioesophageal junction is below the diaphragm but the crura are lax attenuated or absent

Gastroesophageal Incompetence—Its Relationship to Short-Esophagus Type of Hiatal Hernia in Infancy. Regurgitation or reflux of gastric contents into the esophagus due to incompetence or relaxation of the usual sphincter mechanism at the esophagogastric junction has been well established in recent years as a cause of vomiting in early infancy Considerable confusion and difference of opinion exist regarding

the relation of hiatal hernia and short esophagus to gastroesophageal incompetence and regarding the existence of true congenitally short esophagus.

Maurice Tatelman and Irving F. Burton[3] (Detroit Mem'l Hosp.) report on an infant who showed definite evidence of gastroesophageal reflux causing severe persistent vomiting with no evidence of hiatal hernia or esophageal shortening initially. With some persistence of the condition, despite therapy, a definitely shortened esophagus and a moderate-sized hiatal hernia developed. This sequence of events would tend to substantiate the theory that, at least in some patients, gastroesophageal regurgitation is primary and that this then produces esophagitis and, in response, a shortening of the longitudinal fibers of the esophagus, thus leading to hiatal hernia. The authors believe that this mechanism of formation of short-esophagus type of hiatal hernia in childhood or infancy is therefore similar to that described in the adult in association with hiatal hernia and esophageal regurgitation.

It has been postulated that a faulty neuromuscular mechanism, possibly excess vagal stimulation or sympathetic inhibition, is the cause of gastroesophageal regurgitation in infants A similar causative mechanism has been proposed in adults.

Diaphragmatic Hiatus Hernia and Its Surgical Treatment are discussed by E. Derra and H. Reitter[4] (Med. Academy of Dusseldorf). Hiatus hernias have been divided into four groups: (1) congenital, with short esophagus (Bailey's "thoracic stomach"); (2) congenital, without short esophagus; (3) paraesophageal; and (4) sliding.

Patients with group 1 hernias should be operated on as soon as diagnosis is established. The same holds for those with group 2 hernias, in whom, because of the size of the hiatus, the entire stomach may be displaced into the chest. Similarly, patients with paraesophageal hernias should be operated on early, especially when the hiatus is narrow and the chances of incarceration great. With sliding hernias, indicatons for surgery are: constant, disabling symptoms; significant anemia even without subjective symptoms; and prolapse of over one half of the stomach into the chest. In this type late symptoms or sudden complications may be ex-

(3) Gastroenterology 33 991-997, December, 1957
(4) Deutsche med. Wchnschr. 84 582-588, Mar 27, 1959.

pected Complications of a sliding hernia constitute absolute indication for surgery, which carries a 50% mortality Surgery should be performed before incurable esophagitis, esophageal stenosis, intermittent incarceration or bleeding sets in Even advanced age is not a contraindication for surgery although the authors would not operate on persons over age 68

With the foregoing indications as criteria, surgery was performed on 81 patients Most were aged 50 69 Of these, 91% had symptoms and 6% had anemia only, whereas 3% had no symptoms but underwent surgery because of the size of the hernia In 27 patients, one third of the stomach, in 39 over half and in 15 practically the whole stomach was in the chest cavity During x ray studies the hernia was reducible in 10 patients only

Surgery is aimed at restoring normal anatomic relations This is possible only by intervening at the site of the hernia The approach may be abdominal or transthoracic Today, the latter is preferred

Among 107 operations there were 4 operative deaths, 3 of those patients were poor risks whereas the fourth died of a myocardial infarct on the 12th postoperative day Postoperative complications, such as pleural effusion, thrombophlebitis, parotitis, pneumonia or pulmonary infarct, occurred in 10 3% There were 5 recurrences About 80% of the patients became asymptomatic

Abdominal Repair of Hiatal Hernia. Study of 138 Cases E Stanley Crawford and Michael E De Bakey[5] (Baylor Univ) treated hiatal hernia surgically in 138 patients, aged 32-85 who had no relief from other measures All complained of pain Dysphagia and bleeding were present in more than 35% The transthoracic approach was used in 24 patients and the abdominal in 114 The transthoracic route was used in most patients treated in the early study period, but during the past 4 years, this approach was used only in patients having other thoracic lesions The increasing preference for repair by the abdominal route was caused by the frequent association of other lesions, such as cholelithiasis, duodenal ulcer and leiomyoma of the intestine In such patients, associated lesions may be surgically treated at the same time that the hernia is repaired if the abdominal route is used

(5) Am Surgeon 24 889 895 December 1958

TECHNIC.—The abdomen is opened and thoroughly explored through an upper midline incision extending from the xiphoid process to the umbilicus (Fig. 110, A). The region of the hiatus is exposed by retraction of the left lobe of the liver upward and to the right and of the stomach and transverse colon downward (Fig. 110, B). This maneuver reduces the hernia by drawing the stomach and lower esophagus into the abdominal cavity. The peritoneal reflection overlying the region of the abdominal esophagus is incised transversely.



Fig. 110.—A, abdomen is opened through upper midline incision. B, hernia exposed by retraction of liver medially and stomach downward. C, hernia is reduced by downward traction on stomach and peritoneal reflection overlying esophagus is incised. (Courtesy of [illegible] 24: 889-893, December 1958.)

The esophagus is mobilized by blunt dissection and encircled with umbilical tape using a Semb's ligature carrier (Fig. 110, C). Downward and lateral traction is applied to the esophagus and after the upper portion of the gastrohepatic ligament is divided, the superior and right margins of the hiatus are exposed by sharp dissection. Downward traction on the esophagus is shifted medially and the left margin of the hiatus is exposed in similar manner. After the entire hiatal opening has been completely exposed, repair can be accurately accomplished. The medial and lateral crural margins of the enlarged

hiatus are approximated behind the esophagus with interrupted no 1 silk sutures (Fig 111, *A*) Both margins of the hiatus may be exposed and suturing facilitated by retraction of the esophagus laterally Traction on the first sutures conveniently brings in view the rest of the hiatus to be sutured If both margins of the hiatus cannot be exposed simultaneously, the left margin is exposed by retraction of the esophagus medially (Fig 111, *B*), and after the sutures have been placed in this side, the esophagus is shifted laterally to expose

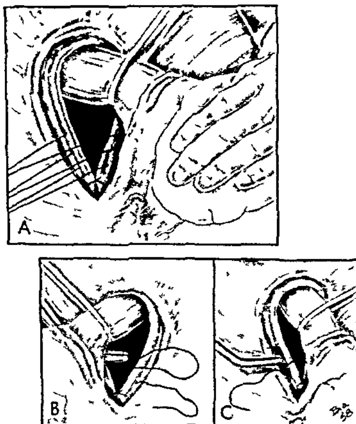


Fig 111 —*A* esophagus is retracted laterally, and medial and lateral crural margins of enlarged hiatus approximated behind esophagus In some patients both margins of hiatus cannot be exposed simultaneously Accordingly *B* with esophagus shifted medially, sutures are first placed in left margin of hiatus *C*, sutures are carried behind esophagus and placed in medial crural margin with esophagus retracted laterally (Courtesy of Crawford E S and De Bakey, M E Am Surgeon 24 889 895 December 1958)

the right margin The medial ends of the sutures are then carried behind the esophagus with a Sembs ligature carrier After the needles have been reapplied to the sutures, the exposed right margin is sutured (Fig 111, *C*) Sutures are placed and tied until the hiatus is narrowed to admit the esophagus, a no 16 Levin tube inserted preoperatively and the operator's index finger To restore the valvelike function of the hiatus, its margins must continue to act as a *sling in* the right crus of the diaphragm Consequently, sutures are not placed in the hiatus anterior to the esophagus This precaution also prevents excessive narrowing of the hiatus and subsequent esophageal obstruction Large sutures are essential for the strength provided by such

material and to prevent cutting of muscle, often caused by fine sutures in this region

The esophagogastric junction is attached to the undersurface of the new hiatal opening by 6 8 interrupted silk sutures that are passed through the redundant peritoneum and seromuscular layer of the esophagogastric junction on one side and the peritoneum and musculotendinous tissues on the diaphragmatic side After these sutures are tied, the redundant peritoneum of the hernial sac is imbricated the

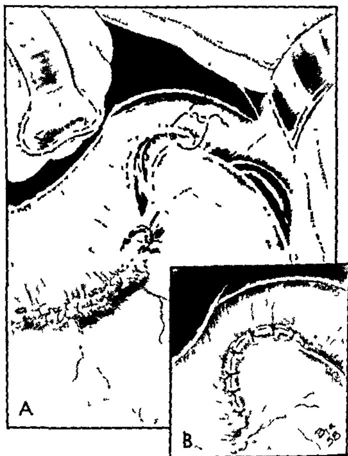


Fig 112—*A* and *B* operation is completed by attachment of esophagogastric junction to undersurface of new hiatal opening (Courtesy of Crawford E S, and De Bakey M E Am Surgeon 24 889 895 December 1958)

peritoneal incision is partially closed and the esophagogastric junction becomes firmly attached to the undersurface of the diaphragm (Fig 112) Reuniting the gastrohepatic ligament completes closure of the peritoneal incision

Hiatal hernias recurred in 2 patients who had thoracic repair and in 4 who had abdominal repair Symptoms were relieved in all who had successful abdominal repair

Treatment of Short Esophagus with Stricture by Esophagogastrectomy and Antral Excision is reported by F Henry

Ellis, Jr, Howard A Andersen and O Theron Clagett[6] (Mayo Clinic and Found) in 20 men and 7 women, aged 39 77 (average age 54 7) Symptoms, consisting chiefly of pain, regurgitation or vomiting, bleeding and dysphagia, were present 6 months to 32 years (average 5 8 years) Dilatation had been done repeatedly over prolonged periods before surgical intervention, and weight loss was significant Bleeding occurred in 8 but was the chief indication for operation in only 2 In 24, the basic cause of the pathologic process in the esophagus was a diaphragmatic hernia Three patients had had cardioplasty for achalasia of the esophagus elsewhere

All but 1 patient survived operation A woman, aged 64, died on the 3d postoperative day of perforated gastric ulcer distal to the suture line Of the other 25, 2 were operated on too recently for evaluation The others were followed (18 by re examination) 7 months to a little over 3 years All but 1 were completely relieved of preoperative symptoms, and none had had a recurrence One operated on for esophageal stricture required multiple dilations and was still showing dysphagia Four required 1 or 2 dilations in the immediate postoperative period, but all were well for a year or more

Although symptoms were relieved in 23 patients, 8 were classified as having a good and not an excellent result and 1 as having a fair result Of the 8 with good results, 2 showed occasional nausea and vomiting, 2 some regurgitation and nausea, 2 regurgitation, 1 anorexia and 2 diarrhea The patient with a fair result showed troublesome regurgitation Mild symptoms of dumping were present in several patients in the early postoperative period but regressed or disappeared in all No patient showed megaloblastic anemia

Gastric acidity was measured in 20 patients, and all were achlorhydric after a test meal and after administration of insulin, free acid occasionally was recovered after administration of histamine Fecal excretion of fat was increased, an average of 15 1% of ingested fat being excreted over 6 days when patients received a diet which contained 100 Gm fat daily

The procedure of esophagogastrectomy and antral excision is satisfactory treatment for certain patients with a

(6) Ann Surg 148 526 536 October, 1958

short esophagus who fail to respond to medical management A short esophagus with stricture is the principal indication A less extensive operation may suffice in the absence of stricture, massive bleeding or deep esophageal ulceration with destruction of the integrity of the esophagogastric junction

Leiomyomas of the Esophagus, according to H W Lueders A Stranahan, R D Alley, H W Kausel and A S Peck[7] (Albany, N Y), occur as frequently in men as in women of any age group They develop anywhere along the esophagus, singularly or as multiple nodules, and may be pedunculated or intramural The pedunculated tumors are more usual in the upper third of the esophagus They tend to ulcerate and bleed and occasionally are discovered when they are regurgitated or coughed into the mouth The intramural tumors occur more commonly in the middle and lower thirds of the esophagus rarely ulcerate, bleed or calcify and sometimes are associated with diaphragmatic hernias Usually they are asymptomatic, but they will produce symptoms late when they encircle the esophagus and obstruct it or the adjacent bronchi Malignant degeneration is rare

Leiomyomas may be suspected when symptoms of dysphagia, substernal or chest pain, regurgitation vague epigastric distress and anorexia appear and can be associated with fluoroscopic findings of mediastinal densities which may or may not move with deglutition On barium swallow, a horizontal shelflike appearance at the junction of the normal and involved esophageal walls is considered diagnostic Esophagoscopy is often negative showing only the smooth intact mucosa and extrinsic compression by tumor When diagnosis is suspected biopsy is not recommended since it impairs later enucleation of the tumor and may result in bleeding or infection Bronchoscopy should be done in high lesions to rule out fistulous connection with a primary tumor in the tracheobronchial tree

Of 4 cases reported by the authors 1 is of particular interest in that the leiomyoma was calcified and had an associated diverticulum

Construction of New Esophagus by Means of Transverse Colon and Its Application for Caustic Atresia, Carcinoma and Varices of Esophagus Report of 26 Cases is pre

(7) A M A Arch Otolaryng 67 587 591 May 1958

sented by Edwin Benedito Montenegro and Daher E Cutait[8] (Univ of São Paulo)

METHOD—After the abdomen is opened through a right-sided Lennander incision, the large omentum is dissected free from the transverse colon and hepatic and splenic flexures are freed Ligature of the right and medial colic vessels and marginal arcade at the proposed levels of colic section is performed. Nutrition of the transverse colon to be used for esophagoplasty is thus guaranteed only by the left colic vessels Ascending and descending colons are cut close to the hepatic and splenic flexures, and re-establishment of intestinal continuity is effected by end-to end anastomosis between ascending and descending colons, with two rows of interrupted cotton sutures. The isolated loop of colon is passed through an opening made in the gastrohepatic omentum, thus avoiding compression by the great gastric curvature of the mesentery harboring the left colonic vessels. The excluded transverse colon is placed in the left subphrenic region and the abdominal wall closed

While the abdominal wall is being closed, left cervicotomy is performed medially to the sternocleidomastoid muscle down to the pleural cupola by another team of surgeons The esophagus is exposed, dissected and divided After the patient is turned on the side left thoracotomy is done through the 8th intercostal space, the diaphragm is opened and the excluded transverse colon is brought up to the pleural cavity An opening is made in the pleural cupola by combined cervical and intrapleural digital maneuvers The proximal stump of colon is exteriorized up to the cervical wound through this opening after the colon is placed in the paravertebral gutter behind the lung Anastomosis of the distal stump of the colon to the gastric fundus is made with two rows of interrupted cotton sutures. The diaphragmatic opening is closed, not too tight around the colon, to avoid compression of its mesentery The thoracic wound is closed after a drainage tube is passed through the 10th intercostal space The patient is returned to supine position, and anastomosis between esophagus and colon is done with two rows of interrupted cotton sutures (Fig 113). The cervical wound is closed and the operation completed (Fig 114).

When the lesion affects the cervical and thoracic esophagus, anastomosis of the colon is made with the hypopharynx When the lesion involves the stomach, causing retraction and fibrosis, anastomosis of the colon is made with a jejunal loop When a previous subtotal gastrectomy has been done, anastomosis of the colon is made with the efferent jejunal loop of the gastrojejunal anastomosis

In most cases of cancer and varices, the operation is best performed in 2 stages First, total thoracic esophagectomy is done through a right thoracotomy, the cardia is closed, and the cervical esophagus is brought out through a left cervical stab wound Gastrostomy is constructed for temporary feeding In the next stage, *2 or 3* months later, after the general condition has improved, esophagocoloplasty is performed

Esophagocoloplasty was done in 26 patients The 14 with

(8) Surgery 44 785 794, November, 1958

atresia were aged 7-32, and in all but the youngest, atresia resulted from ingestion of caustic soda. Only after failure of other treatment was this operation done A two-stage procedure was used in 9, but preference recently has been given to the one-stage operation, performed on 5 patients. Ten men, aged 43-60, were operated on for cancer of the esophagus and 2, aged 24 and 29, for esophageal varices.

Of 5 postoperative deaths, 2 each occurred in the atresia and cancer and 1 in the varices group. Main postoperative complications in surviving patients were injury to the left

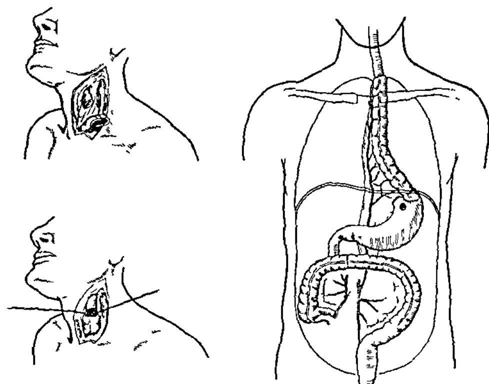


Fig 113 (left) —Anastomosis between cervical esophagus and colon
Fig 114 (right) —Final aspect of operation Esophagocolic and gastrocolic anastomosis
(Courtesy of Montenegro, E B, and Cutait D F Surgery 44 785 794, November, 1958)

recurrent nerve and esophagocolic fistula. The former occurred in 3 patients and was followed by paralysis of the corresponding vocal cord Esophagocolic fistula occurred in 6 patients, was mild in all and healed spontaneously in 2-3 weeks Complementary operation was unnecessary

All patients started to swallow without difficulty after the operation, except 3 in whom anastomosis was made to the hypopharynx; with proper re-education, these 3 were also

able to swallow quite well Swallowing was also normal as soon as healing occurred in patients with esophagocolic fistula Slight regurgitation on recumbency in 3 patients subsided spontaneously within a few weeks All patients with atresia gained weight (up to 35 lb in 1 year) and showed improvement in general condition Of 8 patients with cancer who survived the operation, 3 died of metastasis 11, 14 and 15 months postoperatively, 1 was living almost 4 years and 1 about 9 months after resection and 3 were not followed The only patient with varices who survived was well 15 months postoperatively with no recurrence of bleeding

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THE STOMACH AND DUODENUM

Endocrine Influences of Pancreas on Gastric Secretion I Effects of Glucagon and Alloxan on Heidenhain Pouch Secretion were studied by Henry W Mayo, Jr, and Daniel M Enerson[9] (State Univ of New York, Syracuse) The hydrochloric acid output of Heidenhain pouches in dogs in the fasting state over 5 hours was compared before and after intravenous administration of glucagon Six of 9 animals showed decrease in acid secretion, 1, no change, 1, moderate increase, and 1, marked increase Glucagon did not act as a consistent stimulus to gastric acid secretion and may even inhibit such secretion

Alloxan diabetes was produced in 8 dogs equipped with Heidenhain pouches, and the acid secretions from these pouches over 5 hours were compared before and after administration of alloxan A definite increase was noted in acid secretion from the pouches in alloxan treated dogs in the fasting state as compared with amounts noted in pre alloxan studies This increase was more marked and more apparent when the dogs were allowed water and still more marked after the stimulus of a standard meat meal

► [The findings of these investigators are intriguing The authors postulate that the increase in gastric secretion following the development of alloxan diabetes might be the result of an inhibitory hormone secreted by the beta cells which was abolished by the action of cytotoxin Evidence will be necessary to confirm or disprove these observations However, it forms an attractive explanation for the pathogenesis of the Zollinger Ellison syndrome —Ed]

(9) Surgery 44 91 98 July 1958

Hemodynamics of Gastric Secretion was studied by Richard M Peters and Nathan A Womack[1] (Univ of North Carolina) in experiments on dogs designed to show the relation between distribution of blood flow in the stomach wall and production of gastric acid When the dog stomach was perfused with histamine, and then a mixture of rice starch granules in gelatin solution was injected into the left gastric artery, the main arterioles to the villi could be well demonstrated

When India ink perfusion was used after histamine, the finer capillary bed became apparent When small glass beads were perfused, the yield was scant, and the diameter of the beads obtained never exceeded 25 μ

When the dog stomach was first perfused with epinephrine, and a mixture of rice starch granules in gelatin solution was injected into the left gastric artery, there was scant visualization of the blood supply to the mucosa The same was true with India ink preparations after epinephrine perfusion The submucosal vascular plexus, however, was larger, and with starch preparations, arteriovenous anastomoses could be demonstrated in the submucosa When glass beads were perfused the yield was larger, and the diameter of the beads recovered was as great as 125 μ Since beads of such size could not possibly have passed through the capillary bed, it must be assumed that they passed through arteriovenous anastomoses Such anastomoses were visualized

Concomitant studies of gastric acid secretion and arterial, splenic and portal vein pressures and oxygen saturations were carried out Control levels were established, and to one group of animals histamine was given, to another epinephrine and in a third the vagus nerves were stimulated in the chest

Histamine injection and vagus stimulation caused an increase in portal and splenic venous pressure with no change or a slight fall in oxygen saturation Output of acid was increased With epinephrine there was a marked rise in portal and splenic venous pressure and oxygen saturation was almost arterial in level Acid secretion was depressed When sufficient histamine to produce severe hypotension was given there was a fall in portal and splenic venous pressure,

[1] [illegible] 1958

a considerable fall in portal and splenic oxygen saturation, and acid secretion was absent

These findings may be interpreted as demonstrating that when hydrochloric acid is secreted by the stomach, energy requirements are so great that increased blood flow through the stomach with increased flow through the mucosal capillary bed is essential When acid is not being secreted, much of the capillary bed in the mucosa is closed, and the arterial blood is shunted directly into the veins by arteriovenous anastomoses in the gastric submucosa

Effect of Complete Exclusion of Stomach on Fat and Nitrogen Absorption is reported in 5 dogs by Louis Plzak, Linda Price and Edward R Woodward[2] (Univ of California, Los Angeles) Three consecutive experimental situations were studied (1) the entire stomach was excluded by a Roux Y esophagojejunostomy, (2) secretions of completely isolated stomach were drained to the exterior through a gastric cannula, and (3) the stomach was removed Complete exclusion of the stomach from intestinal continuity by a Roux Y esophagojejunostomy produced a moderately severe defect in absorption of ingested fat and nitrogen, which was not altered by division of the pylorus and total loss of gastric secretions to the exterior This would render it unlikely that entrance of gastric juice into the small intestine influences digestive processes at this level After total gastrectomy, again no significant change in absorption of nitrogen and fat occurred Hence, it is unlikely that the stomach exercises any endocrine influence over digestive processes in the small intestine All animals lost weight progressively throughout the experiment That this loss tended to decelerate during the 2d and 3d stages reinforces the conclusion that the excluded or isolated stomach exerts no beneficial effect on digestion or absorption

Clinical Patterns of Peptic Ulcer after 60 were studied by Condict W Cutler, Jr[3] (Roosevelt Hosp, New York) in 430 patients, of whom 319 were men Distribution of ulcer location was duodenal, 286, gastric, 126, both duodenal and gastric, 8, and marginal, 10 The site of the gastric ulcers was on the lesser curvature in 121 and on the greater curvature in 5 In 8, the gastric ulcerations were multiple Rela

(2) Surgery 44 299 302 August 1958
(3) Surg, Gynec & Obst 107 23 30 July 1958

tively few ulcers developed for the first time after age 60 and these often manifested themselves by severe hemorrhage or perforation, with symptoms of short duration or sometimes without premonitory signs

The most common late complication of ulcer creating a true emergency was hemorrhage, and in a fair proportion of patients bleeding had occurred before, perhaps periodically, over a period of years When bleeding was the first ulcer symptom occurring after 60, it was likely to be particularly severe and dangerous Perforation of stomach or duodenum was the second serious emergency in point of numbers It usually occurred in old and chronic cases of ulcer and less frequently as the result of late-developing ulceration Obstruction of the stomach, although a less acute emergency, still demanded active treatment for relief if the patient were to survive, almost without exception, ulcer complaints were long standing A larger group of patients had symptoms of many years' duration Tolerance had been exhausted, and they sought relief from the intractability of the ulcers

Many cases of hemorrhage, especially if massive or recurrent, demanded surgical intervention When conditions were favorable and circumstances warranted, subtotal gastrectomy was justifiable and safer than continuance of bleeding In most instances, it was successfully undertaken Perforation of the stomach or duodenum demanded surgery, and simple closure was safest In obstruction and intractability, unless the status of the patient was favorable and there was reasonable assurance of the safety of subtotal gastrectomy, it seemed best to use a less hazardous, if less ideal procedure, except when cancer was seriously suspected

In hemorrhage, unless massive and continuing or recurrent in obstruction of moderate degree and in many cases of intractability—in all types of complication, i e except perforation—results of medical therapy were impressive

Evaluation of Surgical Treatment of Intractable Duodenal Ulcer should be based principally on the patient's nutritional status late in the postoperative period, according to Robert M Zollinger[4] (Ohio State Univ) In 203 unselected ulcer patients who had various operations 1 6 years previously, 109 (over half) failed to regain their preoperative weight Ideal weight should be given important considera-

(4) A M A Arch Int Med 102 607 61? October 1958

tion in planning the type of surgery If the patient is underweight, conservative procedure, such as vagotomy combined with gastroenterostomy, pyloroplasty or hemigastrectomy, is advised If the patient is well below ideal weight, vagotomy and gastroenterostomy should be considered unless there is active bleeding Eating habits and nutritional status of the patient in relation to ideal weight are extremely important pre- and postoperatively

Weight trends were particularly gratifying in patients who had vagotomy, hemigastrectomy and small stoma gastroduodenostomy Most who weighed over 145 lb before operation lost some weight, but most below this figure gained There was a definite increase in the percentage of patients who held their ideal weight or who reached ideal weight compared to those who had more radical resection combined with the Billroth II type of anastomosis These satisfactory weight trends were surprising because almost 8 of 10 patients drank coffee and smoked after operation and about the same proportion took alcoholic beverages

The trend toward conservative resections should further decrease incidence and severity of the so called postgastrectomy syndrome The importance of avoiding radical gastric resection in a thin person cannot be overemphasized Although the perfect operation for duodenal ulcer has not been developed, most patients are so grateful for liberation from ulcer pain that wider acceptance of earlier surgery is suggested in management of the "stubborn" case of duodenal ulcer

► [Duodenal ulcer remains a disease which should be primarily managed by nonoperative treatment We agree however, with Zollinger that the results of surgery are sufficiently good that they should not be denied any patient who has difficulty controlling his ulcer symptoms over a period of a few years unless the operative risk is prohibitive. Many patients unfortunately limp along under a medical regimen requiring strict dietary management over a period of many years only to develop a serious catastrophe such as massive bleeding or perforation requiring *emergency* operation in old age when diseases in other organs such as the heart or kidney increase the hazard of surgery Under such circumstances the mortality of gastric resection is high and the patient has undergone many years of discomfort which could have been prevented The advantages and disadvantages of surgery must be carefully weighed for each patient, but there should be wider appreciation of the fact that *the mortality* rate for surgical management is now sufficiently low that the risk to a patient with long standing ulcer disease may be less than that of the ...mary disease ... ns Thus, surgi... frequent recur...

Surgery of Duodenal Ulcer Reginald H Smithwick[5] (Boston) presents an evaluation of various surgical procedures, based on gastric acidity as judged by achlorhydria under fasting conditions and after stimulation by beef broth and insulin Clinical experimental studies suggested that removal of less than half the stomach, combined with vagotomy, did not give high enough incidence of achlorhydria to duplicate the protection against recurrent ulceration afforded by subtotal gastrectomy alone

Continued studies indicated that achlorhydria is the result of the combined effect of (1) removal of the antrum (2) removal of a small segment of the body of the stomach (3) complete or incomplete resection of the vagus nerves and (4) regurgitation of bile into the gastric remnant A fifth factor, i e, gradual decrease in secretory activity of parietal cells with passage of time, is suggested by the fact that the longer patients are followed, the higher the incidence of achlorhydria In early years, 14% of 115 patients who had hemigastrectomy with vagotomy showed free hydrochloric acid, compared with 4% in later years Conversely, after subtotal gastrectomy, 36% of 182 patients showed free hydrochloric acid 1-2 years postoperatively and 39% 2 6 years postoperatively

Among 190 patients with subtotal gastrectomy operative mortality was 2 6% among 135 with hemigastrectomy and vagotomy, it was 2 2% Clinical results in the two groups were excellent in 23% and 41%, good in 41% and 46%, fair in 24% and 9% and poor in 12% and 4% Gastrojejunal ulcer was proved in 3 and suspected in 15 with subtotal gastrectomy, whereas none with hemigastrectomy and vagotomy showed recurrences Most deaths in both groups were due to complications related to management of the duodenal stump If these could be eliminated mortality would be under 1% in both groups

When judged on both a physiologic and clinical basis hemigastrectomy with vagotomy is a satisfactory operation for treatment of duodenal ulcer and is the author s procedure of choice The high incidence of achlorhydria which appears to be increasing with time suggests that patients so treated will rarely be troubled by recurrent peptic ulcer in the late postoperative period Excellent and good clinical

(5) Am J Gastroenterol 30 145 160 August 1958

results predominate, and incidence of severe and distressing postoperative symptoms is lower than after subtotal gastrectomy

Results of Gastrectomies for Ulcer: Statistics on 400 Cases are reported by A Bonniot, J Bonnet-Eymard and Y Bouchet[6] Operations were performed on the same service by 7 surgeons using the same Hofmeister-Finsterer technic Age distribution of patients was under 30, 15 5%, 30-40, 25%, 40 50, 32%, 50 60, 16%, over 60, 11 5% Males predominated (90%) Ulcers were in the stomach in 124 (31%), duodenum in 256 (64%) and were gastrojejunal or recurrent in 20 (5%) Operative indication was hemorrhage in 32, perforation in 28, secondary operation in 27 (20 of these were for peptic ulcer, 7 after gastrectomy and 13 after gastroenterostomy) and progressive benign ulcer in 313

There were 6 postoperative deaths (1 5%) Complications occurred in 13 patients (3 25%) and were pulmonary, wound dehiscence, gastrointestinal hemorrhage and perigastric abscess in 3 and pancreatic fistula in 1 Eleven patients died several months to 5 years after operation Of 354 patients operated on 2 years or more before, 255 (72%) were followed radiologically and clinically Six had late complications related to the gastrectomy which required secondary operation Five of these recovered satisfactorily after the second intervention One with psychic disturbances complained of severe symptoms following gastrectomy, but a second operation failed to reveal any lesion One patient with jaundice due to hepatitis 6 months after operation for duodenal ulcer was treated medically In 7 patients, pulmonary tuberculosis developed after gastrectomy

Among the group of 7 gastrojejunal or recurrent peptic ulcers that followed gastrectomy, only 3 operations had been performed by the authors, i e, the percentage of recurrent ulcers in their series was 1 17% Two patients were successfully treated by the Dragstedt operation through the thorax but the third continued to have symptoms after this secondary procedure One had peptic ulcer of the anastomosis the others had recurrent ulcer of the small curvature

As sequelae of gastrectomy, 38 patients complained of epigastric distress after eating, this was always mild and

(6) Lyon chir 54 343 353 May 1958

tended to disappear with time A mild dumping syndrome developed in 7 (2 5%) and improved with a special dietary regimen in all but 1—a neurotic woman with anemia Only 4 patients had hypochromic anemia which responded readily to treatment When all failures and sequelae are considered, 74% of 255 patients had an ideal result, and by elimination of temporary sequelae, this figure increases to 93 3% in whom the final result was satisfactory Weight gain was recorded in 50%, 40% regained normal weight and only 10% had a slight loss of weight, without any functional difficulty Normal occupation was resumed by 96%, the others changed to lighter work No patient was incapacitated as the result of operation

Late Prognosis after Partial Gastrectomy for Ulcer· Follow-up Study of 361 Patients Operated on from 1905 to 1933 is presented by Urban Krause[7] (Univ of Uppsala) Of 385 patients treated with Billroth II gastrectomy, 94% were traced, 210 had died The number of deaths to be expected statistically was 163 1, this difference is highly significant statistically

Carcinoma of the stomach was diagnosed as the cause of death in 25 patients The number of deaths to be expected statistically from carcinoma of the stomach was 11 3, this difference is statistically significant If the series is divided according to sex, deaths from carcinoma of the stomach among men amounted to 16, as against the expected 6 6, a difference also statistically significant Among women, the number of deaths noted was 9 and the expected mortality 4 7 This difference is not completely significant statistically The number of years elapsing between operation and death from carcinoma of the stomach was, on the average, 24 3, the longest interval being 39 and the shortest 6 The youngest patient was 48 and the oldest 86, with the mean age at death 68

In most patients, the carcinoma was situated at the gastroenterostomy stoma or in its immediate vicinity on the stomach side As a result, in several instances the growth was first interpreted roentgenographically as jejunal peptic ulcer and treated medically If a patient wholly free from symptoms for many years after operation shows jejunal ulcer of the peptic type, carcinoma should always be

(7) Acta chir scandinav 114 341 354 1958

suspected The carcinoma was situated in the cardia in 4 patients Besides the 25 patients, 2 others had operation for low esophageal cancer

Pulmonary tuberculosis caused death in 24 patients The mortality to be expected from pulmonary tuberculosis, calculated statistically, was 8 7, the difference is highly significant statistically This excessive mortality might be explained by the fact that nutritional uptake is inadequate in many gastrectomized patients

Eight men and 1 woman committed suicide Official mortality statistics forecast a suicide incidence of 2 among men and 0 5 among women Suicides were particularly numerous among older men, the group in which anemia was also common The inference might be that the fatigue and general distress attendant on anemia aggravates the postcibal symptoms and leads to depression This, in turn, increases the tendency to suicide among those who are so disposed

Most survivors were satisfied with results of the operation No severe postcibal symptoms were noted The incidence of jejunal peptic ulcer in the whole series was slightly over 3% Anemia was fairly common, with just a third of the survivors reporting one or, more commonly, several episodes of fairly marked anemia Routine check of the blood values should be made in gastrectomized persons

Billroth I and Billroth II Reconstructions Clinical Comparison of Results of Two Methods, as presented by J Lynwood Herrington, Jr[8] (Vanderbilt Univ), is based on two groups of patients with benign gastric and duodenal ulcer In 107 patients gastric resection with an end-to end gastroduodenostomy (Billroth I) and in 209 subtotal gastric resection with a conventional Billroth II reconstruction or a modification were performed All patients with duodenal ulcer had bilateral subdiaphragmatic vagotomy in addition to resection Age range was 21-77 and follow-up was 6 months to 11½ years The postoperative hospital stay in the Billroth I and II groups was about equal 9 and 9 1 days, respectively In the Billroth I group, there were 3 (2 8%) hospital deaths and in the Billroth II group, 8 (4%) deaths Two of the 3 patients in the Billroth I group who died were elderly men who had surgery for duodenal ulcer, 1 was a diabetic

(8) Surgery 44 1040 1053 December 1958

woman, aged 80, who had emergency gastric resection for bleeding superficial benign pyloric ulcer All 8 patients in the Billroth II group who died had duodenal ulcer, only 1 of these deaths could be directly attributed to a technical error in performance of surgery

In the Billroth I group, including the 3 patients who died in the hospital, 21 (19%) significant complications occurred among 20 patients Obstruction at the gastroduodenostomy stoma was the commonest complication, which resulted from technical fault, it occurred in 7 (6 5%) patients and required reoperation in 5 In 6, obstruction became apparent during the early postoperative course

In the Billroth II group, the complication rate, including deaths, was also 19% (38 complications in 36 patients) In 8 (3 8%) of the 209 patients with Billroth II reconstruction, stomal obstruction developed, in 5, prolonged gastric suction alleviated the obstruction One patient died later and stomal revision became necessary in 2

Significant postoperative hemorrhage was noted in 3 (2 8%) patients of the Billroth I group and in only 2 (0 9%) of the Billroth II group, in 1 proving fatal A leak at the anastomotic site was seen in 1 patient in the Billroth I group and a leak from the duodenal stump occurred in 3 (1 4%) in the Billroth II group In each patient the fistula closed spontaneously There was no injury to the common bile duct in either series In 1 Billroth I patient, the transverse colon was injured, resulting in a fecal fistula that required later closure No pancreatitis was diagnosed in either group Among complications that were not related directly to the gastric reconstruction, the commonest were vascular disturbances

Of 105 patients in the Billroth I group followed 6 42 months, only 7 (6 7%) lost weight after operation Of 193 in the Billroth II group, 30 (15 5%) had weight loss of 10 40 lb ; 27 had been operated on for duodenal ulcer and 3 for benign gastric ulcer Symptoms suggestive of dumping though not severe, were noted in 24 (23%) of the patients with Billroth I reconstruction Dumping occurred in 72 (37%) patients in the Billroth II group, but was severe in only 5 (2%) Only one duodenal ulcer recurred in the Billroth I group and in the Billroth II group there was no suspected or proved recurrence among 180 patients who had vagotomy and antral resection for duodenal ulcer Among 13 patients

with gastric ulcer who had Billroth II reconstruction, there was recurrence in 1

In the Billroth I group, results were excellent in 80 (76%), good in 17 (16%), fair in 6 (6%) and poor in 2 (2%) In the Billroth II group, results were excellent in 123 (64%), good in 50 (26%), fair in 13 (7%) and poor in 7 (3%)

The author's experience indicates that when possible Billroth I reconstruction should be performed on a woman with gastric or duodenal ulcer and in most men with benign gastric ulcer Billroth II reconstruction has proved safest and is preferred for the large posterior penetrating duodenal ulcer that cannot be safely or completely removed, it is also more suitable for obese persons

► [Our experience with the Billroth I procedure summarized in the following report by Fisher and Jordan, supports the observations of others who have found such a high incidence of recurrent ulceration that the procedure has been abandoned Herrington's observations concern gastrectomy plus the additional procedure of vagotomy The results of this technic need further evaluation Until additional experience is recorded the Billroth II reconstruction appears to be the procedure of choice with or without vagotomy It should be noted that these remarks pertain specifically to the treatment of duodenal ulcer The Billroth I procedure remains a good operation for gastric ulcer—Ed]

Billroth I Gastrectomy for Treatment of Duodenal Ulcer is described by Peter B Fisher and George L Jordan, Jr [9] (Baylor Univ) The Billroth I gastrectomy was performed on 95 men and 1 woman, aged 22 78 None had combined gastric and duodenal ulcerations and none had had a previous operation on the upper gastrointestinal tract The indications for surgery included bleeding in 30 patients, acute perforation in 25, obstruction in 7 and intractability in 34 In most patients, 75% or more of the stomach was removed

Three patients died within 30 days after operation, an operative mortality rate of 3%, 2 of these had emergency subtotal gastrectomy for massive, uncontrollable hemorrhage Nonfatal postoperative complications developed in 14 patients Of the 93 patients who survived operation, 84 (90 3%) were followed 8 months to 5½ years Three patients died in the late postoperative period, none of these deaths was related to the problem of gastroduodenal ulceration

The dumping syndrome was seen in 47 (58%) patients, it was mild in 30, moderate in 16 and severe in 1 In many patients, the symptoms improved spontaneously with the

(9) Am Surgeon 24 922 926 December 1958

passage of time. Only 4 patients failed to regain their preoperative weight.

In 11 (13.1%) patients, symptoms of recurrent ulceration developed and an ulcer was confirmed by roentgenographic or gastroscopic examination. Four of these were subsequently treated surgically and 7 were managed nonoperatively.

Each patient was asked to state his opinion of his postoperative result; 35% considered their results excellent and 21% poor. Technically, the Billroth I gastrectomy proved satisfactory. The authors had no difficulty in accomplishing an anastomosis without tension, regardless of the

COMPARISON OF INCIDENCE OF RECURRENT ULCERATION AFTER BILLROTH I AND II GASTRECTOMY FOR DUODENAL ULCER. COLLECTED SERIES

Author	Billroth I			Billroth II		
	No. of cases	Recurrent ulceration		No. of cases	Recurrent ulceration	
		No.	Per cent		No.	Per cent
Ordahl (1955)	35	10	28.6	64	4	6.2
Ross and Meadows (1952)	37	6	16.2	72	0	0.0
Golligher (1956)	132	14	10.6	138	1	0.7
Fisher and Jordan (1958)	84	11	13.1	136	5	3.7
Wallensten (1954)	111	14	13.6	190	2	1.0
Walters (1957)	27	2	7.4	449	16	3.6
Horsley (1957)	102	4	4.0			
Kanar (1956)	248	2	0.8			
Moloney (1954)	49	0	0.0	37	1	2.8
Total	825	63	7.6	1,086	29	2.7

amount of stomach removed, though occasionally division of one or two additional short gastric vessels was necessary and rarely the second portion of the duodenum was mobilized. Stomal obstruction in this series was not a problem.

Comparison of late results in this series with those after the Billroth II gastrectomy in the same institution revealed that the patients' nutritional status was somewhat better after gastroduodenal anastomosis because only 5% (including those who were obese preoperatively) had weight loss in excess of 5 lb. In contrast, 28% of the patients treated by gastrojejunostomy had weight loss exceeding 5 lb., including 11% in whom weight loss was associated with difficulty in adjusting to a satisfactory diet.

A tabulation of unselected reports gave an average incidence of 7.6% marginal ulceration after the Billroth I proce-

dure, compared to 27% after the Billroth II gastrectomy (table)

Vagotomy and Pyloroplasty in Chronic Duodenal Ulcer with Special Reference to Technic were studied by Gordon K Smith and Jack M Farris[1] (Los Angeles) Subtotal gastrectomy, pyloroplasty and gastrojejunostomy have all benefited ulcer patients in varying degrees, through extirpation of acid secreting mucosa, through some neutralization effect or through a combination of the two The addition of vagotomy to any of these procedures substantially increases their effectiveness Of patients subjected to subtotal gastrectomy alone, 50% may show free hydrochloric acid, provoked by sham feeding and reversed by atropine When vagotomy is added, this figure is reduced to 5% Vagotomy alone has proved ineffectual in treatment of duodenal ulcer

Of 151 consecutive patients in whom vagotomy was combined with all three of these procedures, about half were operated on over 5 years ago and a few, over 10 years ago During the first 5 years about half of these patients had modest subtotal gastrectomy with vagotomy and during the past 5 years the other half had pyloroplasty or gastroenterostomy with vagotomy Detailed study of a questionnaire returned by 112 of these patients indicated 7 unsatisfactory results In only 1 of these 7 patients was there proved recurrent duodenal ulcer Three patients indicated unsatisfactory result because of symptoms related to dumping All of these occurred in the gastrectomy group In 2 other patients, there was equivocal evidence of ulcer at the primary operation and their persistent symptoms are characteristic of a functional disorder One other had unsatisfactory result because of recurrent gastroenteritis In excess of 90% of the patients indicated excellent result

Though theoretically resection of the antrum to abolish the gastric phase of digestion and division of the vagus nerves to nullify the cephalic phase offers maximum protection to the ulcer patient in the authors' series, there is no evidence that this method gives results superior to vagotomy and pyloroplasty

Management of Perforated Peptic Ulcer was appraised by Clarence J Berne and William P Mikkelsen[2] From 1940

(1) A M A Arch Surg 78 652 659 April, 1959
(2) Surgery 44 591 603 September 1958

to 1958 2,154 cases of perforated peptic ulcer were diagnosed
at the Los Angeles County Hospital, 1,854 were duodenal
and 298 gastric Simple closure of the perforation was the
usual method of treatment Annual operative mortality was
5 20%, with an average of 10 9% for those treated surgi
cally Mortality was about 4% for patients aged under 50
and about 16% for those over 60 The sharp rise in mortal
ity after the 5th decade parallels a similarly increased mor
tality in patients with treatment delayed over 12 hours

The mortality for patients with gastric ulcer perforations
was greater than for those with duodenal ulcer perforations
Gastric ulcer seldom occurs in younger age groups The high
frequency of chronic alcoholism malnutrition, old age con
current disease and late hospitalization after perforation
causes great complexity in management of acute perfora
tions of peptic ulcer

The standard method of management of gastroduodenal
perforation due to peptic ulcer should be simple closure of
the perforation This method assures positive control of
the lesion The necessary laparotomy largely eliminates di
agnostic error Mortality is rarely due to the method itself
Gastric suction alone will control the perforation in many
patients There is no proof that it does more than demon
strate the frequency of self sealing However, a rapid and
precise method for determination of such sealing might
eliminate need of emergency surgery in many patients

In selected patients ulcer curative surgery can be applied
at the time of perforation with low mortality It is justified
only when there is adequate evidence of the presence of pro
gressive ulcer disease

Shock is the most overlooked lethal factor in patients with
acute perforation and is probably the dominant feature pro
ducing the steep increase in mortality in patients aged over
55 Reduced blood volume is characteristic of older persons
who also have reduced vasomotor capacity to compensate for
sudden hypovolemia These patients are often hospitalized
late after gastroduodenal perforations

If proper roentgenographic studies are made pneumo
peritoneum can be demonstrated in about 80% of all cases
of acute perforated ulcer Actively leaking ulcer perfora
tion may exist in absence of pneumoperitoneum

► [As noted in previous issues of the YEAR BOOK we are of the opinion

that a more aggressive attitude is warranted in the treatment of perforated ulcer The advisability of performing gastrectomy in the absence of previous symptoms may be questioned, but on the other hand, the criteria for gastrectomy outlined by these authors in their publication are far too strict In a 1-5-year follow-up study of 74 patients treated by immediate subtotal gastrectomy at the Veterans Administration Hospital (Houston), the results were classed as good or excellent in 89% —Ed]

Fluorescein String Test for Localization of Upper Gastrointestinal Hemorrhage: Preliminary Report is presented by Donald W Traphagen and Mitchell Karlan[3] (Ohio State Univ)

METHOD AND MATERIALS —A thin 1/32-in gauze umbilical tape 's used for string A radiopaque marker is imprinted longitudinally nto the string for 7 ft , and the string is cross-marked with the same naterial at 1-in intervals (Fig 115) A small 2-Gm shot is attached) the end of the string to facilitate swallowing and passage through e pylorus Fluorescein (5%) is processed with sodium bicarbonate his sterile solution is not toxic and can be given in comparative

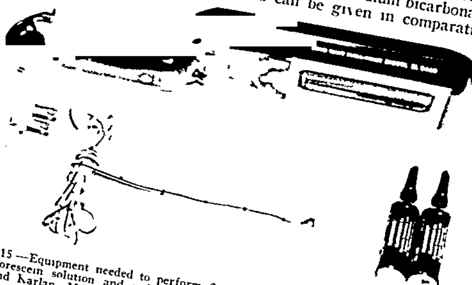


Fig 115 —Equipment needed to perform fluorescein string test—ultraviolet light, sterile fluorescein solution and radiopaque marked string (Courtesy of Traphagen, D W and Karlan M Surgery 44 644 645 October 1958)

amounts as normal saline without difficulty An ultraviolet light or small Mineralight is also used

The string is moistened with water and usually can be swallowed without difficulty A flat film of the upper abdomen is obtained 2-3 hours later to determine the location of the string The end of the string should be passed to at least 2 ft beyond the ligament of Treitz Course and progression of the string are followed by noting the radiopaque markers and their relation to the pylorus If the patient is having active gastrointestinal bleeding, 20 cc fluorescein is injected into an antecubital vein After 5 minutes, the string is removed, examined for evidence of gross blood and taken to a darkened room and examined against a dark background with an ultraviolet light

(3) Surgery 44 644 645 October 1958

If no blood or fluorescein is noted on the string no active or recent bleeding has occurred in the area passed by the string, or the string was above the point of hemorrhage If the string contains only blood and no fluorescein, no active bleeding was occurring at the time of the test but bleeding had occurred in that area in the past If the string contains both blood and fluorescein, active bleeding is occurring, and the site of the dye indicates the point of origin of the hemorrhage This is determined by matching the place where dye occurs on the string with its comparable location on the x-ray film If appearance of the dye on the string seems equivocal, fluorescein can [illegible] 'he string in a trough of

[illegible] astica, pre- and postpyloric ulcers, a marginal ulcer, esophageal varices and a duodenal carcinoma has been localized by the string test Further trial of the test is advised

Depression of Gastric Secretion and Digestion by Gastric Hypothermia: Its Clinical Use in Massive Hematemesis was studied by Owen H Wangensteen, Harlan D Root, Conrad B Jenson, Kamil Imamoglu and Peter A Salmon[4] (Univ of Minnesota Hosps) The esophagus in cats rats and dogs was examined after perfusion with gastric juice from patients with duodenal ulcers

Experimental animals were cooled to 20 C Control animals under normal temperatures revealed marked ulceration of the esophagus, whereas the cooled animals showed little or none Studies of temperature influence on the digestive ability of frogs and fish showed that when body temperature was in the middle 20's, active digestion occurred but when temperature was 2 C, little or none took place

No studies using systemic cooling were made in man because of the dangers of ventricular fibrillation Satisfactory lowering of gastric temperature was obtained by perfusing cold 50% alcohol-water solution at low temperatures through a small, thin-walled balloon attached to a double lumen tube that the patient swallowed In addition, a nasogastric tube was placed in the stomach for gastric compression

TECHNIC —A refrigeration unit maintained the alcohol water solution at 2-5 C This solution was pumped into the intragastric lying balloon through a no 320 polyethylene tube with a lumen of 1 mm The circulatory fluid returned to the chamber through the larger plastic outflow tube with an internal diameter of 6 mm Rate of flow was regulated by a valve on the intake side of the pump The volume

(4) Surgery 44 265 274 August 1958

of fluid in the balloon and its consequent distention were regulated by varying the backflow from the balloon. The maximal volume of solution that could be forced into the balloon was carefully predetermined by the volume in the cool chamber. The level of fluid in this chamber was accurately regulated by a float arm connected to a microswitch which controlled the pump motor responsible for the chamber-to-balloon circulation (Fig. 116).

To obtain only local cooling of the stomach, the patients were surrounded by warm blankets. Local gastric temperature ranged between 17 and 20 C. without materially affecting general body temperature. This technic of local cooling

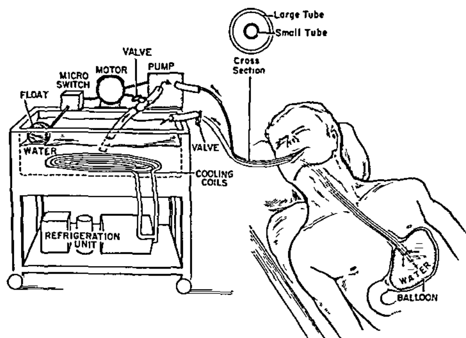


Fig 116.—Device for obtaining local gastric hypothermia. (Courtesy of Wangensteen, O. H., et al.: Surgery 44:265 274, August, 1958.)

produced marked depression of gastric secretion and impediment of digestion.

Local gastric hypothermia, used in 5 patients with massive gastric hemorrhage, favorably influenced arrest of hemorrhage of acid peptic origin. Besides control of bleeding, this management may prove of value in preparing the patient for surgery, by permitting stabilization of vital signs, with restoration of fairly normal blood volume.

Surgical Treatment of Massive Upper Gastrointestinal Hemorrhage is reported by Donald R. Cooper, LeRoy H. Stahlgren, Loring E. Sylvester and L. Kraeer Ferguson[5]

(5) Gastroenterology 34 947 958, June, 1958.

(Philadelphia) in 46 patients (34 men) Peak age incidence was in the 7th decade A history of peptic ulcer was obtained in 31, but 10 of these were bleeding from other sources (8 erosions or acute ulcers, 1 gastric varix and 1 aortic aneurysm) *Four with no history of ulcer were bleeding from* chronic peptic ulcer Of 12 patients with history of alcoholism, 8 were bleeding from chronic peptic ulcers, 2 from acute erosions *and 1* each from gastric varices and acute gastritis Every attempt was made to rule out esophageal varices, and the sole exception represented failure in diagnosis Of 4 patients with uremia at onset of hemorrhage, the 2 who were operated on promptly survived, in the 2 who died, operation was delayed for a week because of poor condition In 6 patients hemorrhage appeared to have been precipitated by significant stress (train wreck, electric shock treatment operation etc) No previous bleeding had been noted in 74% of the patients

Of 13 patients allowed to bleed massively for over 48 hours 4 died (30% mortality) Recently the tendency has shifted toward earlier operation Preoperative diagnosis was incorrect in 37% Diagnosis of peptic ulcer was made in 39, with 64% accuracy Superficial gastric erosions or acute ulcers were rarely diagnosed preoperatively but proved to be the source of hemorrhage in nearly half the patients believed to have chronic ulcer Every preoperative diagnosis of carcinoma was incorrect the only carcinoma found was unsuspected preoperatively

In only 3 of 46 patients, primary operation failed to control the hemorrhage, 1 of these was reoperated on 24 hours after a blind resection, and a bleeding vessel in the duodenum was controlled successfully A patient bleeding from a gastric varix died in shock before hemorrhage could be stopped Another bled to death from an aortic aneurysm which had perforated the fourth portion of the duodenum Thus, there was ultimate failure to control bleeding in only 2 patients Of 19 patients (41% of the series) who required blind resection, 6 (32%) died Two additional deaths occurred among the 46 patients, yielding a mortality rate of 19% That 4 of the 8 patients who died were allowed to bleed for over 48 hours was considered important in contributing to the poor result Patients with other complicating disease should probably be operated on early or not at all

Most of the 46 patients showed a "fatal type" hemorrhage, i e, most would have died without surgical intervention Hence, the survival rate of 81% represents considerable salvage Poor prognosis was evidenced by the following factors (1) hematemesis was noted in 78%, (2) 50% were aged 50 70, with 39% over 60, (3) many had complicating diseases affecting the cardiorenal and respiratory system and (4) an average of 5,300 cc blood was required during hospitalization

Indications for operation for massive upper gastrointestinal hemorrhage are exsanguinating hemorrhage continued bleeding requiring replacement of over 500 cc blood every 8 hours for 48 hours and rebleeding while the patient is hospitalized and on antiulcer treatment The bleeding lesion should be excised unless great risk to contiguous structures is involved, when a simple ligature about the bleeding point may be lifesaving Gastrotomy and/or duodenotomy are not recommended except in unusual circumstances At operation for proved upper gastrointestinal hemorrhage if no lesion is apparent on external inspection and palpation of viscera and if varices have been excluded blind gastric resection can be done with reasonable assurance that the bleeding point will be controlled (88% in this series) Emergency gastrectomy shows a higher mortality than elective gastrectomy, largely because of the precarious state of the acutely bleeding and depleted patients Mortality rate can be lowered chiefly by earlier decision for or against surgical intervention Some patients will be salvaged by operation who would bleed to death on conservative treatment

Emergency Surgical Treatment of Severely Bleeding Duodenal Ulcer is described by John C Westland, Herbert J Movius and Joseph A Weinberg[6] (VA Hosp, Long Beach, Calif) From 1949 to 1956, a combined one stage procedure of vascular ligation pyloroplasty and vagotomy was performed on 24 of 30 patients for massive duodenal ulcer bleeding The others had ligation and pyloroplasty in the initial operation, with vagotomy contemplated as a later procedure under more favorable conditions All 30 showed hypovolemic shock, 85% had hemoglobin values under 60% of normal (average initial value in the group 8 1 Gm /100 cc) and 78% were aged over 40 Average duration of inten-

(6) Surgery 43 897 900 June 1958

sive medical therapy before operation was 80 hours. Each patient received an average of 8 units of blood preoperatively, and in every instance blood was given during the operation, often into more than one vein.

Of the 24 treated by the one-stage procedure, none died. All these operations were emergencies, considered necessary lifesaving measures. One patient required 2 additional operations 1 and 2 weeks later because of recurrent bleeding. The third operation was a Billroth II gastric resection, which resulted in satisfactory recovery. Recurrence of bleeding was attributed to failure to place the figure-of-eight suture deep enough at the original operation.

One of the 6 patients with ligation and pyloroplasty alone had a fatal hemorrhage several days afterward. This occurrence led to the practice of performing the one-stage operation.

The results reveal the superiority of the simple one-stage method over subtotal gastric resection which is almost always a prolonged, hazardous procedure under adverse conditions. Even if bleeding recurs after this procedure, as it did in 1 patient, subtotal gastrectomy may still be done at a more favorable time.

Results of Three Methods of Therapy for Massive Gastroduodenal Hemorrhage: Statistically Valid Comparison of nonoperative, immediately operative and selectively operative regimens in 130 patients is reported by Karl E. Karlson, Irving F. Enquist, Clarence Dennis and Sidney Fierst[7] (Brooklyn). Criteria for admission of patients to the study were (1) vomiting of blood or coffee ground material or passage of tarry stools or unchanged blood by rectum in the 7 days before admission, (2) estimate of more than 0.5 L. blood loss during the preceding 7 days, (3) absence of immediately obvious evidence or history of cirrhosis of the liver with esophageal varices or of blood dyscrasia and (4) absence of any evidence of previous drainage operation or resection of the stomach In all surgical cases the operation selected was 75% gastric resection with short-loop, retrocolic Hofmesiter-Polya gastrojejunostomy. In the immediately operative group, preoperative preparation was limited to 12 hours. The selective operative regimen was based on age, arteriosclerosis, previous massive hemorrhage and

(7) Ann Surg. 148:594-602, October, 1958.

the failure of transfusion to combat shock adequately

There were 58 patients in the nonoperative, 37 in the immediate operative and 35 in the selective operative groups Mortality in each group was 14% The 8 deaths in the group treated medically were attributed to the following causes cancer of the stomach with exsanguination, 1st day, exsanguination, 2d day, transfusion for air hunger and death during transfusion, 2d day, congestive failure, 1st day, exsanguination on 20th day (17 transfusions for anginal pain), coronary occlusion, 4 weeks, perforated gastric ulcer and bronchopneumonia, 5th day, chronic peritonitis and malnutrition, 62d day, following gastrectomy for repeated massive hemorrhage This last patient was considered a failure of nonoperative therapy after four episodes of massive bleeding and shock, gastrectomy was performed on the 10th day of hospitalization In the group subjected to immediate operation, causes of death were perforation of the duodenal stump, 3d day, pulmonary embolus, 15th day, postoperative shock, 2d day, and myocardial infarction, 1st day One preoperative death from cardiac failure occurred in a patient, aged 85 With this case excluded, mortality from immediate gastrectomy was 11% In the group subjected to selective gastrectomy, causes of death were cardiac failure, 1st day, cardiac failure, 3d day, fecal fistula and peritonitis, 31st day, wound dehiscence, atelectasis and pneumonia, 7th day, and gastric dilatation and aspiration on the 5th day in a woman, aged 53, with a lesion interpreted as carcinoma and not resected

Average age in each group was about the same, i e, 54, 55 and 56, respectively, but the patients who died were considerably older, the average being 68, 70 and 61 in the three groups

Experience in 239 patients (from whom the study group of 130 was selected) indicates that selection of patients for therapy of massive bleeding on the basis of a loss of 40% of the calculated normal total circulating red cell mass is extremely useful No patient who had lost less than 40% of the normal total red blood cells died of gastroduodenal bleeding Mortality figures based on groups of patients which include those who have lost less than 40% of their normal red cell mass are less significant than those based on Stewart's criteria

Though most patients in the nonoperative therapy group died of exsanguination, most in the operative groups died of postoperative complications Patients treated nonsurgically may be subject to the same risk from a subsequent hemorrhagic episode, whereas this hazard appears less in patients with gastrectomies

Studies on So called Postgastrectomy Pancreatitis were carried out by W Emory Burnett, George P Rosemond H Taylor Caswell, Eugene W Beauchamp Jr, R Robert Tyson and William C Wright[8] (Temple Univ) A syndrome has been described occurring postoperatively that appears clinically to be pancreatitis, it is a serious though infrequent complication, occurring most commonly after operation on the duodenum The mortality rate is about 50%

The syndrome was observed in 11 patients over 10 year One had transduodenal sphincterotomy with retrograde probing of ducts, and the others, some form of gastric resection Except for 1 patient who had esophagogastrectomy with splenectomy and partial pancreatectomy for carcinoma these were drawn from 662 with gastric procedures Of the other 9, 5 had partial resection for duodenal ulcers 2 total resection for carcinoma 1 extensive subtotal resection for carcinoma and 1 partial resection for a huge perforated gastric ulcer Of the 11 patients 7 died, a mortality rate of 64% Autopsy was done on 5 of these, only 2 showed real pancreatic disease at autopsy

Pancreatic leakage may be the cause of some possibly most syndromes diagnosed as postoperative pancreatitis Differentiation between true postoperative pancreatitis and only leakage from injured ducts can rarely be made except at autopsy Routine serum amylase determinations daily for the first 3 days after gastrectomy may aid in early recognition of the disease Peritoneal lavage if done promptly and thoroughly, according to the author s technic may be of tremendous value in such patients

TECHNIC —Local anesthesia is administered in either lower rectus muscle cephalad enough to miss the empty bladder and caudad enough to miss the deep epigastric vessels A small incision is made to fit the drain as closely as possible A metal sump drain is inserted gently deep into the pelvis using a finger in the rectum to guide it Connection is made by Foley catheter and saline is pumped in to distend the abdomen if leakage about the drain will permit During this

(8) Ann Surg 149 3 745 May 1959

time, the patient is in Trendelenburg position for greater filling The balloon is deflated and the catheter removed The metal inner tube is inserted and all fluid possible is aspirated, with the patient in reverse or White position The technic is repeated several times Warm normal saline is painless and even distention causes little if any, discomfort To avoid complication from the potential introduction of bacteria, 150 200 cc saline containing penicillin and streptomycin is left in the abdomen Probably most of this drains out through the retained sump drain This addition may be superfluous Fowler position and continuous suction on the sump drain are used between sessions Thorough lavage and final antibiotic instillation should be repeated every 6 or 8 hours The patient's progress and the amylase concentrations at the beginning and end of lavage determine when to arrest treatment and remove the drain

Surgical Treatment of Marginal Ulcer. John M Beal[9] (New York Hosp -Cornell Med Center) studied 184 men and 20 women with marginal ulceration Average age was 50 8 Anastomotic ulceration followed gastrojejunostomy in 151 patients and was a sequela of partial gastrectomy in 53 The primary site of peptic ulceration had been located in the duodenum in 149 patients, in the stomach in 7 and in the pyloric canal in 1 In 47 patients, the site of ulceration for which the primary procedure was undertaken could not be determined

In the gastrojejunostomy group, 44 patients were managed without operation Dismantling of the anastomosis and partial gastrectomy were performed in 62 A second partial gastrectomy was done in 4 of this group for recurrent ulceration and an additional patient had transthoracic vagotomy In 29 patients, dismantling of the gastrojejunal anastomosis alone was performed, later resection was performed in 16 of this group Eight patients were treated by vagotomy, later partial gastrectomy was performed in 3 of these Miscellaneous procedures were used in 8 patients

Of 107 patients, after various types of surgical procedures 8 died postoperatively and 5 died of ulcer Thus, the total mortality rate was 12 1% which was related to ulcer in this group Among the 44 patients treated without operation, 5 died of ulcer, a mortality rate of 11 3% However, only 4 (9 1%) of this latter group remained free from ulcer symptoms Of the group treated surgically after appearance of stomal ulceration, 47 are well, some after multiple procedure Excluding 21 patients who were well, but had follow-up of

(9) Am Surgeon 25 1 7 January 1959

less than 5 years, satisfactory results were achieved in 58 2% of 86 patients who were treated by surgery

In the partial gastrectomy group (53 patients), conservative management was followed in 19 patients Higher resection was done in 14 patients, 1 of whom died postoperatively Of 17 who had vagotomy for marginal ulceration after partial gastrectomy, in 13, a transthoracic approach was used and in 4, the vagus nerves were divided by subdiaphragmatic exposure None died in the immediate period following vagotomy Miscellaneous procedures were carried out in 3 patients Of the 19 treated conservatively, only 2 are free from ulcer symptoms and 1 died of complications from ulcer Thirty four patients were treated by surgery and 14 remained well for 5 years or longer If the 7 patients who have been free from ulcer symptoms for less than 5 years after surgery are subtracted from the total number treated by operation 51 9% of this group had been without manifestations of secondary ulceration for 5 years or longer Surgery was fatal in 3 patients

Peptic Ulcers after Gastrectomy J Perrotin L Hollender, *J Validire and J Grenier*[1] *observed 53 personal* cases and 141 collected from colleagues The incidence of recurrent ulcers after gastrectomy by one of the classic technics by the same surgeon or the same team is usually 1 5 2% In the authors series it was 1 3% and in the collected cases 1 42% Time of appearance varies from a few days after operation to 20 years but four fifths of the cases appear from 6 months to 2 years after gastrectomy, 124 recurred during the 1st year 79 between 1 and 5 years and 25 from 5 to 20 years after operation Age range was 10 73 but most patients were 30 50 Males predominated 7 1

All recurrent ulcers develop in an acid medium Reappearance of acidity may be related to insufficient resection either to the right or left Analysis of these cases indicates that chances of improving results by extending the resection to more than two thirds of the stomach are minimal Recurrence of gastric acidity is more frequent and marked after the Pean than after the Billroth II operation Transformation of a Pean into a Polya procedure, without associated gastric resection suffices to render a hyperchlorhydric gastric stump anacid The Pean operation should be

(1) J chir 6 456 473 October 1958

avoided in duodenal ulcers, especially when hyperacidity is present Conversely, gastric ulcers may be treated by a Pean, provided a two thirds resection with removal of the first duodenal segment is achieved

Local causes predisposing to recurrent ulcer are diminution or suppression of alkaline biliary pancreatic fluid at the anastomotic mouth, reflux and stasis in the afferent loop, size and situation of the anastomosis, suture material, operative trauma and vascular disturbances Other factors which may influence recurrence are site of the initial ulcer, its seriousness, repeated operations, unjustifiable primary operations, dietetic errors after gastrectomy, race, heredity and constitutional factors, cerebral lesions, stress factors and pancreatic tumors

The size and location of recurrent ulcers is variable and they occur after all types of gastrectomies The ulcers are solitary in 90% of the cases, but in some cases there are 2, 3 or 4 of different sizes and states of progression

Surgical treatment has the double aim of healing the recurrent jejunal ulcer and reconstructing a correct gastrectomy Mortality in 78 cases of gastrojejunal resections was 4% In 56 of these followed for a sufficient time, surgical results were excellent in 32 (57%), fair in 5 (10%) and poor in 19 (33%) Gastrojejunal resection was combined with some other surgical procedure in 25, with good results in 4 of 6 with duodenal resection, in 2 of 5 with duodenal resection and abdominal vagotomy, in 5 of 10 with abdominal vagotomy and in 3 of 4 with thoracic vagotomy Duodenal resection was performed in 7, with good results in 3 and failure in 1, 3 operations were so recent that statistics on results were unobtainable Abdominal vagotomy was performed in 48 cases with 1 death (in a case combined with gastrojejunal resection), vagotomy was the only procedure in 32 and results were excellent in 14 of 19 (73%) followed sufficiently Seven of 12 patients who had vagotomy combined with some other procedure had excellent results, 3 patients were not followed Thoracic vagotomy was carried out in 61, with no deaths In 44 it was the only procedure, results were excellent in 30 of 39 (76%) of these Figures were not available in 5 instances In 13 patients vagotomies were done after other operations had failed, excellent results were reported in 9 Cure was obtained in all of 4 patients in

whom vagotomy was combined with gastrojejunal resection

In rare cases, i e, of hemorrhagic peptic ulcer recurring after satisfactory gastrectomy and complete vagotomy, total gastrectomy may be the only recourse In the authors' serie this was performed in 1 case, which resulted fatally

Pathogenesis of Anemia after Partial Gastrectomy *I Development of anemia in relation to time after operation blood loss and diet* was studied by I McLean Baird E K Blackburn and G M Wilson[2] (Univ of Sheffield) in 341 patients A progressive fall in hemoglobin levels was found after Billroth and Polya types of operation in males and females The steepest fall was in women aged 50 The anemia was predominantly of the iron deficiency type Only 1 patient had megaloblastic anemia Similar results were not found in patients with peptic ulcers but complete stomachs, when the hemoglobin levels were plotted in relation to the time that the ulcer symptoms had been present Incidence of alimentary bleeding was not greater as judged by tests of fecal occult blood in patients after partial gastrectomy than in others with peptic ulcer

Consumption of an inadequate diet has previously been noted after partial gastrectomy The authors noted that iron intake in men who were anemic after partial gastrectomy was significantly lower than that found in nonanemic patients In the two groups the mean time after operation was similar and the reduced iron supply in some men was possibly a factor in hastening the development of anemia However, it was found that consumption of 11 6 mg iron a day is unlikely to lead to anemia in a male unless some other condition, such as blood loss or malabsorption, is also present The iron intake of the females was considerably below the 12 mg/day regarded as essential for prevention of anemia while menstruation is continuing Females who were not regarded as anemic were observed only in the early period after operation and all eventually became anemic on this diet The evidence thus suggests that reduction of dietary iron after partial gastrectomy is an important factor in the development of anemia in females

The extent to which malabsorption of iron from the diet after partial gastrectomy may be important in the pathogenesis of anemia cannot be determined from the present work

(2) Quart J Med 28 21 34 January 1959

In females, blood loss from menstruation and possibly occasional alimentary hemorrhage, coupled with the low intake of iron, may be sufficient explanation without involving any other factors In most male patients, however, the iron intake was not reduced to a level regarded as dangerous to health Nevertheless, they showed after partial gastrectomy a progressive decrease in hemoglobin that was not seen in other males with peptic ulcers In the absence of evidence of increased liability to bleeding after partial gastrectomy, it seems probable that a reduced ability to absorb iron from the diet may be a contributory factor

II Iron absorption after partial gastrectomy was investigated by Baird and Wilson,[3] using radioactive iron preparations Absorption of Fe^{59}, given as ferrous sulfate with the patient fasting, was not altered by partial gastrectomy Absorption of Fe^{59}, incorporated in rabbit's blood and given with a light meal, was also not affected by the operation When, however, Fe^{59} prepared in this way was given with a full meal, a significant decrease in absorption occurred after partial gastrectomy Patients anemic after partial gastrectomy, who were given inorganic Fe^{59} while fasting, showed slightly enhanced absorption, but when the iron was given in organic combination with food, there was no increase in absorption This difference may be associated with the reduction of the capacity of the upper alimentary tract, which leads to more rapid passage into the lower jejunum and ileum, where iron absorption is much less efficient Patients with intact stomachs and iron deficiency anemia showed enhanced absorption when iron was given with food

Iron absorption in health is adjusted in accordance with the condition of the iron stores in the body Deficiency leads to enhanced iron absorption, and this is clearly a mechanism of great importance in preventing the development of iron deficiency anemias The patients with iron deficiency anemia after partial gastrectomy showed slight increase in absorption of inorganic iron given under fasting conditions This increase however was not as great as might have been anticipated from experience of this dose of iron in anemic patients with intact stomachs, but it is in keeping with the rather slow response to oral iron noted in treatment of the anemia after partial gastrectomy The defective response to

(3) Quart J Med 28 35-41, January 1959

anemia was more clearly demonstrated when Fe^{59} was given in organic form along with food Under these conditions increased iron absorption was still seen in anemic patients with intact stomachs After partial gastrectomy however, little or no augmentation was observed Loss of the ability to augment iron absorption in response to requirements is clearly an important factor in the progressive development of anemia after partial gastrectomy

Hemorrhage and defective diet may be contributory factors especially in younger women but a defect in absorption of organic iron taken with food and particularly inability to increase iron absorption from the diet in response to need, are of fundamental importance in the cause of progressive decrease in hemoglobin levels that follows partial gastrectomy

Experimental Study of Iron Absorption Following Total Gastrectomy. Hypochromic anemia has been observed in man and dogs after total gastrectomy Such anemia usually responds favorably to iron therapy Long continued loss of small amounts of blood from esophagitis impaired absorption of iron in the small intestine and a combination of these factors have been suggested as causes for this anemia Anemia resulting from iron deficiency also has occurred after subtotal gastrectomy

Dean L Mawdsley William Silen William L Weirich Harold A Harper and H J McCorkle[4] (Univ of California) studied the ability of normal and gastrectomized dogs to absorb and utilize iron Oral iron tolerance tests revealed essentially no difference between these dogs in the nonanemic state In the anemic state otherwise normal dogs showed increased absorption of iron whereas totally gastrectomized dogs failed to do so Considerably less hemoglobin had to be removed from gastrectomized dogs than from normal dogs to maintain anemia

An anemic totally gastrectomized dog made rapid recovery with intravenous iron therapy whereas a similar totally gastrectomized animal showed a delayed and poor response to oral iron therapy These experiments are presented as evidence that impaired absorption of iron is a consequence of total gastrectomy and that this is a major cause of the iron deficiency anemia that may occur after gastrectomy

(4) Surgery 44 287 294 August 1958

► [The preceding 3 studies substantiate previous observations concerning iron metabolism following gastric surgery In our own experience anemia is not so great a problem as reported by these authors however we are also of the opinion that when it occurs it is the result of inadequate iron absorption We have observed only 1 patient in whom true pernicious anemia developed following subtotal gastrectomy and as mentioned we have had only a few patients in whom the iron deficiency anemia was serious enough to require measures other than the addition of an easily absorbable form of oral iron to the diet In the occasional patient treatment with intramuscular or intravenous iron will be necessary In such patients prompt response to this therapy can be anticipated but recurrence of anemia is the rule and retreatment will be necessary after a period of months or years Consequently all patients having this difficulty should be followed closely with repeated studies of the blood picture so that anemia may be prevented—Ed]

Intestinal Digestion and Absorption after Gastrectomy

Goran Lundh[5] (Univ of Lund) studied intestinal digestion and absorption in 41 patients after gastrectomy at various levels of the gastrointestinal tract with a method of intestinal intubation in connection with a test meal of known composition More rapid gastric emptying and intestinal passage was found after Billroth II than after Billroth I gastrectomy There was a rapid intestinal passage of one part of the test meal to distal intestinal segments this applied to both the Billroth I and Billroth II gastrectomy It was not possible to determine the volume of this part of the test meal with the methods used In totally gastrectomized patients the whole test meal was rapidly spread out over at least the whole small intestine

At the upper intestinal levels where sampling was more frequent characteristic curves of trypsin concentration for normal persons and gastrectomized patients were obtained during the digestive process The concentration curve in normal persons varied with the amount of the administered test meal but the general appearance was the same

In subtotally gastrectomized patients the concentration curve for trypsin was a reversal of the normal curve at the beginning of the digestive process This was most pronounced in Billroth II patients These patients showed *no* measurable amounts of trypsin in many samples of intestinal content This never occurred in Billroth I patients During the whole digestive process a statistically significant higher concentration of trypsin was noted in the intestinal content recovered from Billroth I patients than in that from Billroth II patients In gastrectomized patients all samples from the

(5) Acta chir scandinav supp 231 1958

with that (3 47%) among 144 with Billroth I resections The patients were aged 28 76 (average age 54)

Four of 5 patients with Billroth I partial gastrectomy had early onset of obstruction, i e, at 4 days or under, and 1 showed obstructive symptoms about 3½ years after resection Onset varied from 4 days to 15½ months among those with anterior resection and from 2 to 8 days in 16 of 17 with posterior resection, in 1 patient it occurred 29 months after operation

All patients showed nausea and vomiting Other prominent symptoms were abdominal distention, cramping pain and hiccups In all, suspected diagnosis of stomal or loop obstruction was confirmed by swallowing of a thin mixture of barium

With posterior resection the transverse mesocolon was the major cause of obstruction in over half the patients Six obstructions occurred because the transverse mesocolon had slipped down from its position above the line of anastomosis and had kinked both the proximal and distal loops, and 4 occurred because the transverse mesocolon was constricting the anastomosis Among anterior resections the greater omentum was the major cause of obstruction in about half the patients In 4 it had encircled the anastomosis and had constricted it One other patient had obstruction when it constricted the distal loop at the anastomosis The greater omentum was the cause of obstruction also in 4 of 5 patients with Billroth I resections

Although the authors do not advocate routine omentectomy during partial gastrectomy, they advise against performing an anterior type of anastomosis in the presence of a large, obese and heavy greater omentum and against wrapping the omentum around the anastomosis to protect against leakage

Of 35 patients requiring exploration for obstruction of the stoma or high small bowel (30 original patients plus 5 with recurrence), 24 had definite causes for the obstruction practically all of which were mechanical It is doubtful that prolonged nasogastric intubation and intermittent obstruction would have relieved any of the causes of obstruction

Of the 30 patients, 7 (23 3%) died in the postoperative period of complications after the original partial gastrectomy or after subsequent exploration Leakage with abscess

formation and peritonitis were the chief causes of death One patient, aged 73, died of coronary occlusion, and 2 on whom autopsy was not done died in irreversible shock

Alterations in Gastrointestinal Tract Function Following Surgery: Nutrition and Dumping Syndrome after Gastrectomy are discussed by Henry Thomas Randall[8] (Mem'l Center for Cancer, New York) About 50% of all patients who undergo partial gastrectomy for ulcer have sufficient nutritional problems to prevent regaining of normal preoperative weight, and the more extensive the resection, the more likely the patient is to have such problems Without special attention, 2 10% will be severely or totally disabled by surgery When total or almost total gastrectomy is required, two thirds or more of these patients can be expected to have severe nutritional problems as a result of operation, and few will regain normal preoperative weight

Problems in absorption of protein and fat occur after both partial and total gastrectomy Stool nitrogen losses exceed normal in only a few patients after partial gastrectomy or vagotomy and gastroenterostomy or modified gastrectomy with vagotomy Protein wastage is increased in a higher percentage of patients after total gastrectomy, but even in these seldom exceeds 2 Gm nitrogen above the normal limit of 2 Gm It is important that protein nitrogen absorption is proportional to intake, and that abnormal losses, if they do exist, can be compensated by modest increases in protein intake, provided that total caloric intake is adequate

Fat digestion appears to be more often and more seriously impaired after various procedures for ulcer and after total gastrectomy Increased stool loss of fat is observed after partial gastrectomy in about half the patients After total gastrectomy only the occasional patient is free from a fat-absorption defect, which appears to be in digestion of fats rather than fatty acids and thus is related to hydrolysis of neutral fats Steatorrhea is relatively mild, seldom exceeding 30% of ingested fat even after total gastrectomy The high caloric value of fats, however, adds significance to the losses and significant caloric deficits may result The percentage of ingested fat absorbed appears to remain relatively constant over wide ranges of oral intake Thus, a moderate increase in fat intake should compensate in calories

(8) S Clin North America 38 583 607 April 1958

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(8) S. Clin. North America 38:585-602, April, 1958.

for those lost in the mild steatorrhea of the postgastrectomy patients Pancreatic substance and bile salts as dietary adjuvants may assist absorption of ingested fats

The dumping syndrome plays an important role in limiting food intake after gastric surgery A small residual gastric pouch, if present, is quickly filled with a calorically suboptimal meal The patient feels full after a small intake and stops eating Superficial questions about gastrointestinal function will reveal only the most serious cases, and true nutritional status cannot be assessed without accurate records of weight to compare with the patient's normal weight and immediate preoperative weight

Patients adapt in time to altered gastrointestinal function, but most of the adaptation probably consists in learning the amount of food that can be tolerated at one time and learning, or being taught, which foods are best tolerated and which should be avoided The necessity for multiple feedings, inconvenient as it often is for patients who work, must be impressed on the patient and his family and should be discontinued only slowly and in stages as the patient demonstrates ability to maintain good nutrition with fewer meals Severe psychiatric problems often coexist but it is a mistake to assume that these are the sole reason that the patients do not eat well The dumping syndrome can be minimized even after radical gastric surgery if from the beginning, the diet is planned with a high protein, moderately high fat and relatively restricted carbohydrate content with at least 6 and initially 7 or 8 small feedings a day A piece of toast buttered on both sides and 1 soft boiled egg or some bacon is a far better breakfast for these patients than orange juice cereal with sugar and homogenized milk dry toast and coffee Patients seem to differ individually in tolerance to liquids with meals and to milk Noncaloric liquids are in general better taken between feedings than with them Increasing the cream content of milk probably increases tolerance as well as caloric content

Patients not only tolerate but enjoy and eat more of a diet planned for their physiologic derangements than they do if left to their own dietary devices Severely malnourished postgastrectomy patients require hospitalization for dietary re-education, and their ability to maintain gains depends largely on family and employer understanding of their spe-

cial needs Most can be managed on an ambulatory basis with sympathetic guidance by the surgeon responsible for their deranged gastrointestinal function

► [The incidence of nutritional problems reported by Randall is much higher than that reported by many other authors Certainly the patient's ability to absorb fat and nitrogen is impaired when measured by accurate metabolic studies but adequate dietary management can compensate to the point that weight loss is prevented in most patients Thus in our own experience this problem has not been nearly so great Following gastrectomy and gastrojejunostomy only 15% of our patients have a weight loss in excess of 5 lb compared with their preoperative status and in only 10% is such weight loss related to inability of the patient to ingest an adequate diet calorically In the other 5% weight loss was considered desirable as the patients were obese preoperatively —Ed]

Treatment of Dumping Syndrome George L Jordan Jr[9] (Baylor Univ) reviews the cases of 400 patients treated by subtotal gastrectomy 300 (75%) had duodenal, 60 (15%) gastric and 14 (3%) gastrojejunal ulcers, 4 (1%) had gastritis and hemorrhage and 22 (6%) carcinoma Symptoms typical of the dumping syndrome were experienced by 144 (36%) Symptoms uniformly appeared during the meal or within 10 20 minutes after ingestion and consisted of nausea with or without vomiting and occasional diarrhea with weakness sweating pallor and/or increased pulse rate Symptoms were mild in 71 moderate in 64 and severe in 9, representing 18 16 and 2% of the total group and 50 44 and 6% of the group with dumping syndrome respectively Follow-up was conducted on 134 (93%) of these patients for 6 months to 4 years after onset of symptoms

About half the patients with mild symptoms desired no treatment and most of the others were satisfactorily managed by diet or postprandial recumbency Only 2 required antispasmodics for complete relief Eight patients with moderate symptoms desired no treatment Only 1 obtained satisfactory control by postprandial recumbency alone, although 6 others used this in combination with dietary control Almost half these patients required antispasmodics as an aid in symptom control Of 49 who desired treatment and were followed complete relief was obtained in 37% and partial relief in 55% Of 4 (8%) who failed to respond to various regimens 1 had complete spontaneous relief after 2 years 1 was not properly treated and the other 2 did not desire further attempts at therapy

No patient with severe symptoms could be managed by

(9) J A M A 16 1067 1066 June 8 1958

diet or combined diet and recumbency Two obtained complete and 1 partial relief when antispasmodics were added Of the other 6, 1 subsequently had spontaneous regression a jejunal pouch was created in 2, 1 of whom had partial relief for about a year, after which symptoms recurred but were satisfactorily controlled by diet alone after correction of blood volume to normal, 1 patient has a severe psychiatric problem which makes control virtually impossible, and 1 feels that a strict regimen interferes with his activities more than do his symptoms One patient was not traced

Of 92 patients who desired treatment in the early follow up period, 55 (60%) obtained complete, 29 (31%) partial and 8 (9%) no relief Spontaneous improvement occurred in 17 (13%), so the number of patients with complete relief increased with time At present 67% of the treated group have complete relief and only 6% have failed to improve (these represent only 1 5% of the entire postgastrectomy group) Four of these 6 patients have continued to work despite symptoms and have not required hospitalization 2 are totally incapacitated

The ideal treatment for this syndrome would be prevention and various technics of gastrectomy have been advocated by different authors to produce a low incidence but none has been uniformly successful in the hands of all investigators The author believes that patients treated for gastric ulcer are less likely to acquire the dumping syndrome than those treated for duodenal lesions regardless of the operation used

Appraisal of Treatment of Gastric Ulcer. Claude E Welch and John F Burke[1] (Harvard Med School) reviewed the records of 367 patients in whom diagnosis of benign gastric ulcer was made Surgery was performed on 221 (60 2%) The diagnosis was confirmed in 205, gastric cancer was found in the rest Three hundred eleven patients had pain 64 nausea 152 vomiting, 77 hematemesis and 95 tarry stools Gastroscopy was carried out 51 times The ulcers were visualized and the diagnosis was correct in 23 instances the question of cancer was raised in 6 and examination was unsatisfactory or the ulcer not visualized in 22 Gastric analysis, done in 160 patients, revealed true histamine achlorhydria in 14

(1) Surgery 44 943 958 November 1958

Cytologic smears, carried out in 187 patients, were unsatisfactory in 24 and doubtful in 9

Preoperative studies emphasized the impossibility of differential diagnosis of ulcer and cancer The 5 year survival of gastric cancer diagnosed preoperatively as benign ulcer, was 50% after resection Surgical therapy for gastric ulcer is justified by the facts that only 20-30% of benign ulcers do well on medical therapy and that 5-10% of apparently benign ulcers are actually cancer However, after gastric resection, about 85% of the patients have good results and only 6% poor results

In the authors' series, the mortality of resection for gastric ulcer was 3 6% The mortality of gastric resection for benign ulcer is and probably will remain for many years throughout the country at a level far closer to 5 than 1%, since gastric ulcer is a disease of middle and old age, and the average age of our population is increasing The postoperative mortality in 47 patients with acute massive hemorrhage or severe grades of anemia was 10 6% and in the 174 without hemorrhage, 1 7% Of these, 16 (7.2%) had cancer

The indications for early operation include a long ulcer history, recurrent ulceration, an episode of severe hemorrhage, obstruction or perforation a large ulcer, ulceration in an achlorhydric stomach or a positive cytologic smear in the presence of a gastric ulcer

In selection of the type of operation, there usually is no reasonable alternative to gastric resection Nearly all ulcers may be treated by some form of distal gastrectomy If, at the time of gastric resection an ulcer apparently is benign, to both the surgeon and pathologist, a cancer operation is desirable when the ulcer is distal to the angulus When the ulcer is higher, the margin of normal stomach proximal to the ulcer may be less, since the danger of cancer is counterbalanced by the undesirability of very high or total gastric resection For the few juxtaesophageal ulcers in which distal gastrectomy is impossible, the authors prefer partial proximal gastrectomy to the Madlener procedure

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elective procedure In this group of patients, the mortality is low and should not exceed 1%, in view of the fact that there are rarely any problems with the duodenal stump This is well illustrated in the experience herein reported The total surgical mortality was 3 6% (8 death in 221 patients), but only 1 operative death occurred in the group of patients without complications, a mortality of 0 5%, which is similar to our own

Our experience also agrees with that of Welch and Burke in that the long term results following surgical therapy are excellent in such a high percentage of patients that surgical therapy is in our opinion the treatment of choice for benign gastric ulcer, in contradistinction to duodenal ulcer, irrespective of the fear of malignancy —Ed]

Gastric Ulcer Survey of Rhode Island Hospital Cases in 10-Year Period from 1946 through 1955 by John R Bernardo, Clarence H Soderberg and Anthony V Migliaccio[2] (Providence, R I) revealed gastric ulcer in 1 of every 289 admissions Of 519 ulcer patients, 50 (33 males) had malignant and 469 (331 males) benign lesions Age range was 15-94, with 60% aged 51 70 Duration of symptoms in the malignant group averaged 1 3 years, compared with 4 7 years for the entire ulcer group There was no significant difference in weight loss between the benign and malignant ulcer patients Massive hemorrhage occurred in 11% of the former compared with 4% of the latter Associated duodenal ulcer or multiple gastric ulcers usually strongly suggest a benign lesion An associated duodenal ulcer was present in only 3 of the malignant group, whereas 31 in the benign group had multiple ulcers and 52 had associated duodenal ulcers On routine examination achlorhydria was found in 14% of the benign group, whereas 24% of the malignant group had elevated acid values

Radiologic technics in the differentiation of benign and malignant ulcers will probably not exceed an accuracy of 90% Gastroscopy has proved unreliable in this regard As a gastric ulcer increases in size, the chance of malignancy also increases However the 5 largest ulcers in this series all over 6 cm in diameter were benign Benign ulcers are more common than malignant ones in all areas of the stomach About 1 of every 5 lesions of the antrum excluding the prepyloric area, were malignant Malignant ulcers demonstrated x-ray evidence of healing under medical management

With elective subtotal gastrectomy for gastric ulcers the operative mortality was 4 1% and the rate of minor complications 30%

(2) Surgery 44 804 812 November 1958

Total Gastrectomy for Benign Peptic Ulcer was performed on 12 patients described by J A Balint and J W P Gummer[3] (London) In 9, operation was done for recurrent anastomotic ulcer, in 3, the lesion was a gastric ulcer mistaken for carcinoma at operation Six patients who had the Roux en-Y reconstruction reported the best results Four of these, all operated on for anastomotic ulcer, are well, eating normal meals and leading normal lives, 20 39 months after operation One patient is well but has lost 20 lb, and the other is well but continues to have pain in the thoracotomy scar Results in 3 patients who had loop reconstruction with lateral enteroanastomosis have not been really successful, although the patients are able to work One has severe steatorrhea, present even before total gastrectomy, but has managed to gain weight with the aid of chlortetracycline The other 2 have lost weight and have bilious vomiting and heartburn Direct esophagoduodenal anastomoses were done in 2 patients Results were excellent in 1, the other has no dyspepsia but has contracted severe pulmonary tuberculosis 4 years and 4 months after operation Creation of an artificial gastric reservoir from a jejunal loop was unsuccessful in the 1 patient in whom it was done

All patients received regular doses of intramuscular vitamin B_{12} and no instance of macrocytic anemia developed Iron deficiency anemia, however is likely to occur, and these patients need additional oral iron, as do patients who have undergone partial gastrectomy

Experience in these 12 patients justifies the conclusion that total gastrectomy *if done with a Roux-en-Y reconstruction*, is a satisfactory procedure for patients with anastomotic ulcers not cured by an adequate partial gastrectomy and vagotomy, and even in patients with simple gastric ulcer in whom operative findings strongly suggest malignancy Nutrition of patients with Roux en Y reconstructions is entirely satisfactory

The patients can eat a normal amount of food and can maintain weight

► [We cannot agree that total gastrectomy should be considered for any but the most intractable problems after all other efforts to control disease have failed —Ed]

Surgical Considerations in Gastric Polyps, Gastric Polyposis and Giant Hypertrophic Gastritis in 74 Cases were re-

(3) Lancet 1 1044 1047 May 17 1958

viewed by Everett Carlson and John Guy Ward[1] (San Francisco) Malignancy was found in 8 of 49 solitary polyps (16 3%) Size seems to be a factor indicating malignancy Indications for surgery include size over 2 cm in diameter, progressive enlargement, bleeding or obstruction and gastroscopic and radiologic findings suggestive of malignancy

Local excision was done in 13 of 49 patients with solitary polyps and partial or subtotal gastrectomy in 21, 15 were treated medically or observed Carcinoma subsequently developed in 1 in whom pathologic diagnosis at time of local excision was benign Survival in 8 with partial or subtotal gastrectomy was 3 months to 12 years Five of the 8 clinically and roentgenographically showed probably benign lesions, and some were observed as long as 6 months Gastroscopy was not done in any of the 5 In 2, one lesion was diagnosed as carcinoma and a second solitary polyp was regarded as probably benign, but in both patients, the polyp was malignant In 1 patient, partial gastrectomy was done for a solitary polyp which was broad based and encroached on the pylorus causing obstruction Subtotal gastrectomy was done in 3 with bleeding, the lesions noted were benign adenomatous polyp, neurogenic sarcoma and a benign inflammatory polyp

Among 22 patients with multiple discrete polyps, the polyps themselves were malignant in only 2 (9 1%), but in 2 others, carcinoma of the stomach was also present If it is assumed that these carcinomas arose from polyps, the percentage of malignancy would increase to 18 2% In 10 patients, subtotal resection was done, with local excision of any polyps remaining in the cardia No recurrence of carcinoma in the stump was observed, but follow-up in many was incomplete Of 6 patients treated for multiple polyps by subtotal gastrectomy, 1 died of carcinoma 6 months after operation, the polyps being malignant, another was deteriorating rapidly, apparently from recurrence of associated carcinoma of the stomach The others were living and well after 3, 5, 12 and 13 years Local excision of multiple polyps was done in 3 patients who were still well up to 2 years One patient with complete gastrectomy and ileocolic [illegible] ent was well 5 years after opera[illegible]n Of 6 patien[illegible] ultiple polyps on whom [illegible] n was done, [illegible] ing 20,

10, 2 and 3 years after the polyps were discovered Two died of unrelated causes

Multiple diffuse polyposis is characterized by innumerable polyps which may almost completely cover extensive areas of the stomach Heredity is most likely a strong factor Of 3 patients 1, who also showed gastric carcinoma and had complete gastric resection with ileocolic replacement, was living and well 6 years later In the 1 patient with familial polyposis (Peutz Jeghers syndrome), the gastric polyps were all benign but an associated polyp (adenocarcinoma) in the jejunum was malignant

Massive or giant hypertrophic gastritis (diffuse gastric polyposis of inflammatory type or pseudopolyposis) is often confused with gastric polyposis and is difficult to distinguish from it This is probably a relatively benign lesion and not a precancerous one of sufficient potential to warrant radical surgery In 1 patient exploration in 1936 for supposed carcinoma revealed hypertrophic gastritis and nothing was done The patient was well 20 years later, and x rays showed marked improvement Conversely a patient with similar symptoms of vague indigestion epigastric distress and slight nausea and with x ray diagnosis of typical giant hypertrophic gastritis was observed for 5 months, when exploration revealed inoperable carcinoma

Exfoliative Cytology as Aid to Diagnosis of Gastric Carcinoma Preliminary Analysis of 116 Cases is presented by Edward J Kurt Charles H Brown Lawrence J McCormack John B Hazard and Doris Belovich[5]

TECHNIC—After the patient is prepared by fasting he is intubated orally with a Levin tube secured with adhesive tape and the stomach is aspirated The stomach is washed with 500 1 000 ml tepid tap water in 100 ml amounts This lavage rids the stomach of much debris which results in cleaner slides The lavage is discontinued when the aspirated solution becomes practically crystal clear and 500 ml acetate buffer solution is immediately introduced into the stomach The Levin tube is then clamped and the patient is rotated 360 degrees during 10 minutes after which the Levin tube is connected to a sink aspirator through a bypass 500 ml flask that has been packed in ice and has been chilling since the start of the procedure to slow down cellular digestion The solution is removed in its greatest amount usually 200 300 mg This collection constitutes the total buffer solution which is centrifuged Slides are prepared of the pooled sediment

(5) Cleveland Clin Quart 25 133 146 July 1958

After collection of the total buffer solution, the Levin tube is connected to a 100 ml syringe The "last drop" of solution is recovered after repeated flushing of the stomach with the residual fluid This collection usually amounts to 20 30 ml of specimen, *the richest in* cellular content After this last collection the Levin tube is withdrawn and discarded The specimen is transmitted to the cytology laboratory in a bucket of ice

In 79 of the 116 patients, cytologic findings were negative, and no operation was performed None of these patients showed *any clinical indications of malignancy* Many of the examinations were performed as controls Of the 79 patients 24 had gastric ulcers that were thought to be benign clinically, were associated with ample gastric acidity and appeared benign on x rays Progress x-rays in these patients showed that the gastric ulcers had healed completely Progress cytologic studies can give added reassurance to the clinician treating a gastric ulcer that appears entirely benign clinically, gastroscopically and roentgenographically The studies were done in some patients who had received Co^{60} teletherapy for complicated peptic ulcer but who showed no evidence of neoplasm

Surgery was done on 37 patients The one false negative cytologic report was on a patient with widespread carcinoma of the stomach, with extension into the distal esophagus The Levin tube could not be well placed because of some esophageal obstruction, and the collection of material was not rigidly controlled This report is considered to have resulted from poor collection technic and not from improper cytologic evaluation Gastric cells were not present on the slides In 2 patients with clinically active gastric ulcers, considered benign by conventional evaluation, false positive cytologic reports on washings were obtained Both patients were operated on, and specimens from each showed dysplastic changes, 1 patient had received Co^{60} teletherapy

Gastric cytology should not be used routinely but in the following situations (1) for diagnosis when there is a possibility, on the basis of clinical (including roentgen) findings, of neoplastic change in the stomach, (2) for annual or semiannual screening of patients with premalignant lesions, such as pernicious anemia, polyposis, with contraindication of effective surgery, and achlorhydria, (3) for follow up evaluation of cellular changes after irradiation for nonneoplastic conditions, (4) for a possible research tool in further evaluation of cellular changes as one of the fundamental

processes in development of carcinoma (5) for confirmation of gastric origin of a neoplasm evident as a metastatic carcinoma and (6) for supportive evidence for trial on medical treatment of patients with clinically and roentgenographically benign gastric ulcers

Calcification in Gastrointestinal Malignancy W A Matthews J I Skandalakis M A Mitchell and H S Weens[6] (Atlanta Ga) report 1 case each of carcinoma of the stomach and of the descending colon in which calcium



Fig 11 Carcinoma of descending colon with shell like e l e (Courtesy of Matthews W A et al Ga troenterolog 34 959 968 June 19 8

(6) Ga troenterology 34 959 968 June 19 8

deposits were sufficiently dense to be visible on radiologic examination

Man, 25, was hospitalized for acute abdominal pain which had begun a few hours before, a similar but milder episode had been experienced 6 weeks earlier Examination revealed right abdominal tenderness induration of the base of the umbilicus and an extrinsic mass 2-4 cm in diameter An abdominal x ray revealed numerous small mottled dense deposits in the descending colon at the level of the iliac crest These were also evident after barium enema At the level of the mottled densities, a well defined filling defect with shelflike edges was noted and the mucosal pattern in this region was markedly distorted (Fig 117) Biopsy from the indurated umbilicus disclosed mucus producing adenocarcinoma, regarded as metastatic

The patient was transferred to a veterans hospital Palliative colostomy attempted for imminent intestinal obstruction was unsuccessful because of massive intestinal adhesions He died 2 days later Autopsy disclosed mucinous adenocarcinoma with metastases to regional lymph nodes peritoneum omentum mesentery and diaphragms Histologic study showed calcium deposits in mucinous spaces of the carcinoma

Only about 10 cases of calcification in a gastrointestinal malignancy have been reported, but the pattern of stippled and tortuous concretions seems to be characteristic The small deposits largely follow the contour of the involved gastrointestinal segment Contrast studies reveal marked constriction of the involved gastrointestinal lumen due to the diffuse infiltrating character of the neoplasm These calcifications are sufficiently characteristic to aid substantially in diagnosis of carcinoma Most patients in whom calcification of gastrointestinal carcinoma was observed belong to the younger or middle age group Only 2 of 10 were over 50 and 6 were 40 or younger Despite the infiltrative character *of the new growth the clinical course was often protracted*

Carcinoma of Stomach Claude E Welch and Earle W Wilkins, Jr [7] review data on 637 patients admitted to Massachusetts General Hospital during 1947 57 For determination of 5 year survivals, the 380 patients appearing to Jan 1, 1953, form a special group Patients with malignant lymphoma were excluded Comparison of results in these patients with those observed at the same institution during 1922-46 shows a striking improvement in survival rate Important variables that contribute to determination of survival rates include nature of tumor, length of interval between onset of tumor and treatment, and type of treatment

(7) Ann Surg 148 666 681 October 1958

The number of patients who had palliative resections or resections for cure, with mortality rates, is seen in Table 1. Mortality among resections for cure was subtotal distal resection, 6.2%, subtotal proximal resection, 7%, total gastrectomy, 14.5% and extended total gastrectomy, 15.4%. Among the 380 patients in the special group, 49 survived 5 years (12.9%), 7 of these died later of cancer. Five year survival was 49% for patients who had distal subtotal gastrectomy and survived operation, 14% with proximal gastrectomy, 11% with total gastrectomy and 18% with extended total gastrectomy.

Factors that have affected improvement in results include earlier diagnosis, with particular attention to patients with

TABLE 1.—DISTRIBUTION OF CASES AND MORTALITY
JAN. 1, 1947 TO JAN. 1, 1957

	Number of Cases	% of Total	Deaths	Mortality Per Cent
No operation	53	8.5	17	32
Exploration only	106	16.6	8	7.5
Palliative (excluding resections)	49	7.7	5	10.2
Palliative resections	154	24.1	37	24
Resections for cure	275	43.1	24	8.7
Total	637		91	14.3

supposedly benign ulcers, polyps or pernicious anemia, increased number of operations, and more radical resections, particularly for cancer involving other organs by direct extension. Some patients who had radical resection would previously have been considered to have inoperable lesions. Those with no nodal metastases who survived operation now fare almost the same as 10 years ago, survival was 48% from 1937 to 1951 and is 51% now. Prognosis in those with metastasis has improved significantly, from 5% to 17%. Table 2 shows survival rates in relation to metastases in patients with resection for cure seen up to Jan. 1, 1953.

It might be inferred from the rather narrow spread in mortality for the various resections that the more extensive operations with greater chance of cure should be used routinely. However, this low mortality has been achieved by careful surgical judgment, with selection of, in most instances, the maximal resection that the patient will tolerate. Furthermore the frequent incidence of severe weight loss and dumping symptoms after total gastrectomy is a strong

argument for subtotal gastrectomy When total gastrectomy is done for benign disease, about 30% of patients remain gastric cripples

Because of the relatively high cure rate after distal subtotal gastrectomy for cancer of the distal stomach and the low incidence of postoperative crippling, a more radical procedure is unnecessary unless direct tumor extension requires it Five-year survivals after such resections for cure were obtained in 47%, if nodes were negative the survival rate was 63% For large cancers of the cardia or entire stomach, total gastrectomy, with splenectomy and hemipancreatectomy, seems preferable The exact operation should be

TABLE 2—SURVIVALS WITH RESECTIONS FOR CURE AND RELATION TO METASTASIS JAN 1 1947 TO JAN 1 1953

	Nodes Negative			Nodes Positive		
	No of Cases	5 Year Survivals	%	No of Cases	5 Year Survivals	%
Subtotal gastrectomy*	46	29	63	55	13	24
Total gastrectomy	14	3	21	19	1	6
Extended gastrectomy	7	2	29	13	1	7
Total	67	34	51	87	15	17

*Includes 3 patients believed to have palliative resections but who survived 5 years free from disease

selected carefully as mortality rises with the extent of the procedure Small cancers obstructing the cardia particularly if they arise in a hiatus hernia, may be treated by proximal subtotal gastrectomy

By assigning a single reason for each of the 49 five year survivals location of the cancer appeared to be most important, in 16 instances, the lesion arose in the antrum or prepyloric area, producing symptoms at an early favorable date and in 3, similar obstruction at the cardia led to early operation Extensive operation was instrumental in 16 patients, in 3 of whom extensive resection was done despite the belief that the operation was palliative Operation for lesions believed to be benign ulcer led to 5 survivals and operation on polypoid lesions to 5 more Early operation despite negative x-rays accounted for 2, in 1 of these patients the gastroscope suggested diagnosis and in the other continuing massive hemorrhage led to operation Secondary resection led to 5-year survivals in 2

► [We agree with Welch and Wilkins that extremely radical surgery for the treatment of gastric carcinoma *in the pyloric end of the stomach*

does not significantly improve the survival rate A resection must be adequate to encompass the tumor with a wide margin of normal tissue to remove the primary areas of nodal drainage, but the increase in mortality rate following more radical procedures negates any improvement in long-term survival rate which may occur and impairs the nutritional status of those patients who do survive—Ed]

Prognosis of Stomach Cancer. The fate of cancer patients depends on the spread of the tumor and on its localization Radical surgical removal of the tumor will favorably influence the clinical course in some patients

H Denck and F Helmer[8] (Univ Clinic, Vienna) reviewed the records of 1,429 patients with gastric cancer hospitalized during 1933-55 The cancer was located in the fundus (cardia) in 25 4% Resection was possible in 43 2% Operability seemed to depend on the localization of the tumor, 65% of the antral, 44% of the corpus and 39% of the fundus cancers were resectable Length of clinical history and patients' ages did not affect the operability

The primarily surgical mortality during the first 4 weeks after gastric resection for cancer was 21 5% Mortality increased with the patient's age and was highest with cardia cancer (33 5%) and lowest with antrum cancer (14 3%) The postoperative mortality with partial resection was 16 8% and with total gastrectomy, 33 6% During the recent year, the over-all postoperative mortality has decreased due to antibiotics and the effective treatment of shock Thus, since 1951 the mortality after total gastrectomy has decreased to 29% and the mortality of partial resection to 11%

Follow-up studies were conducted on 420 patients The survival rate with radical surgery was 67 5% after 1 year, 46% after 2 years, 36% after 3 years and 28% after 5 years Thus, the 5-year cure rate calculated for all patients hospitalized for gastric cancer was 8 5%

Permanent cure depends largely on the type of tumor and the lymph node involvement Among patients with localized cancers the 5-year survival rate was 38%, whereas among those with infiltrating expanding cancers, it was 19% Lymph node involvement decreased the chances of survival considerably even if the tumor could be removed completely

The surgical results may be improved by postoperative

(8) Chirurg 29 289 294 July 1958

chemotherapy which could help also those patients in whom only palliative surgery is feasible

Primary Lymphosarcoma of Stomach Clinical Study of 75 Cases is presented by A I Friedman[9] (Mount Sinai Hosp, New York) The study group included 64 patients with small round cell lymphosarcoma and 11 with reticulum cell lymphosarcoma who were followed for 20 years Diagnosis was made by pathologic examination of the resected specimen There were 45 men and 30 women, aged 28 73

The average duration of symptoms for the entire series was 9 months varying from 2 weeks to 4 years The commonest complaint was abdominal pain, which was present in 63 patients The pain was diffuse or located high in the epigastrium the right upper quadrant or periumbilical region, with occasional radiation to the right shoulder Fourteen patients complained of vomiting, dysphagia was present in 6 Evidence of gastrointestinal bleeding was found in 21 Weight loss was a prominent factor in 15

Physical examination was contributory in 30 patients a mass being present in the right upper or left upper quadrant In addition hepatomegaly was found in 16 patients and splenomegaly in 8 Lymphosarcoma as a definitive diagnosis was recognized by x rays 6 times and as a presumptive diagnosis in 9 instances Gastroscopy was performed in 16 patients and esophagoscopy in 4, lymphosarcoma was diagnosed in 6

Surgery was performed on all patients Subtotal gastrectomy was the procedure in 38 subtotal gastrectomy and duodenectomy in 7 and esophagogastrectomy in 6 In 12 total gastrectomy was performed In another 12 only biopsy of the lesion during laparotomy was obtained

The lesion was located in the corpus in 21 patients involving the anterior and posterior walls the posterior wall the greater curvature and lesser curvature in that order of frequency The antrum was involved in 20 patients the pylorus in 10, both the antrum and pylorus in 5 and the cardia in 4 The lesion was classified as diffuse in 15 patients i e, when over 50% of the stomach was involved

Pathologic examination of the resected specimens revealed that the lesions can be divided grossly into five forms infiltrative ulcerative (Fig 118) nodular, polypoid and

(9) Am J Med 26 783 796 May 1959

combined These represent progressive stages in the growth of the neoplasm The ulcerative form, present in 33 (42%), was the commonest type encountered

Fifteen (20%) patients were alive more than 5 years after diagnosis was established or died after 5 years of other causes, with no evidence of recurrent lymphosarcoma Seven

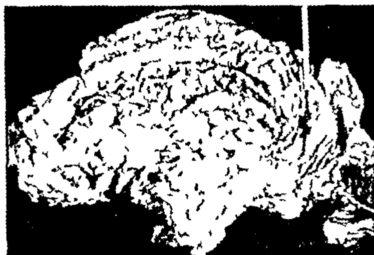


Fig 118—Stomach infiltrated by huge flat lesion 5-cm ulceration was present in its center (Courtesy of Friedman A I Am J Med 26 783/96 May 1959)

are alive and presumed to be cured more than 10 years after surgery, with no evidence of recurrence

The most effective program of treatment is definitive surgery followed by radiation

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THE SMALL INTESTINE

Serum Amylase Levels in Experimental Intestinal Obstruction Observation of Amylase Activity of Abdominal Fluid in Dogs with Complete Small Bowel Obstruction Thomas F Boyd and John J Byrne[1] (Boston) found that the amylase activity of the serum is increased in dogs with complete mechanical small bowel obstruction that are allowed to eat and vomit Increase of the amylase activity of the serum occurs whether the obstruction is high or low and whether or not the dogs are maintained with parenteral fluids and electrolytes This elevation of the serum amylase is not due to increase in the amylase content of the abdominal

(1) Surgery 45 742 750 May 1959

fluid that intestinal obstruction may produce The serum amylase may rise when no free abdominal fluid is present When abdominal fluid does form because of intestinal obstruction, its amylase activity is never greater than that of the serum drawn simultaneously so long as intestinal continuity is maintained

One group of animals had a level of amylase in the abdominal fluid exceeding that in the simultaneously drawn serum Each of these dogs had perforation of the gastrointestinal tract with outpouring of the intestinal contents into the abdominal cavity The perforation was due to a leak at the suture line or, in the Mann Williamson dog to a perforated jejunal ulcer In one of these dogs was the serum amylase markedly elevated The rise, if it did occur, was never of the same magnitude as it was in the dogs without abdominal fluid This furnishes further proof that transudation is not a factor producing elevation of the serum amylase in simple complete mechanical small bowel obstruction in dogs

An elevated serum amylase level is usually indisputable proof of acute pancreatitis It is becoming more apparent however, that the serum amylase may be elevated in other diseases such as mumps, cerebral trauma, administration of opiates and renal insufficiency The authors' observations in dogs may be correlated with the occasional finding of high amylase levels in patients with perforated ulcer, in which the mechanism has been thought to be the escape of the gastroduodenal contents into the free peritoneal cavity with the amylase being rapidly absorbed into the blood stream

Intestinal Obstruction of Congenital Origin Study of Diagnosis and Management in 163 Cases at Children's Hospital, Columbus, O (1944 56) is presented by H William Clatworthy Jr and James R Lloyd[2] Congenital intestinal obstruction may be due to intrinsic obstruction (atresia and stenosis) neuromuscular defects (primary intestinal aganglionosis) anomalies of rotation and fixation (malrotation, volvulus internal hernia congenital bands), intraluminal obstruction (meconium ileus or meconium plugs) extrinsic lesions (annular pancreas duplication neoplasm) and meconium peritonitis (Figs 119 and 120)

Of 56 deaths in this group, 43 could be considered avoidable Diagnostic inaccuracies accounted for 22, technical sur

(2) A M A Arch Surg 75 880 890 December 1957

gical errors and management for 12 and infection for 9 The other deaths were due to unavoidable causes, such as associated anomalies, complications secondary to mucoviscidosis and inadequate intestine

X-rays are the most efficacious diagnostic tool Flat and upright roentgenograms should be obtained on all patients with intestinal obstruction suspected, and careful evaluation of gas and mass shadows, fluid levels and calcifications

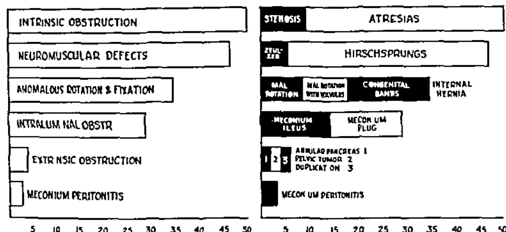


Fig 119 (left) —Causes of congenital intestinal obstruction in series
Fig 120 (right) —Breakdown of causes of congenital intestinal obstruction in series
(Courtesy of Clatworthy H W Jr and Lloyd J R A M A Arch Surg 75 880 890 December 1957)

is usually diagnostic In low or indeterminate obstruction barium enema is necessary to differentiate obstructions of the large and small bowel and Hirschsprung's disease from the meconium plug syndrome

General management is aimed at establishing fluid and electrolyte homeostasis and correcting hypovolemic states, early definitive surgical intervention, with restoration of gastrointestinal continuity, without undue soiling and careful postoperative management Extensive resection of the small bowel can be done without serious permanent growth impairment End to end or end-to side enteroenterostomy is preferred for restoring continuity except in duodenal obstruction or meconium ileus Early temporary colostomy is recommended for symptomatic infants with primary aganglionic megacolon Attention to these principles resulted in reduction of mortality from 52% in 46 patients treated before 1951 to 27 4% in 118 treated since 1951

Intussusception is discussed by George B Packard and

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(?) A M A Arch Surg 75 880 890 December 195

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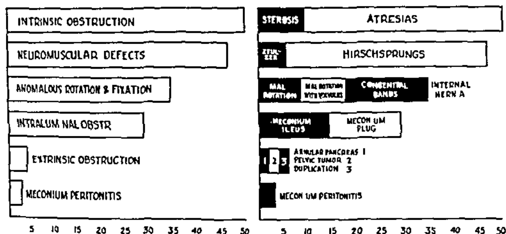


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Intussusception is discussed by George B Packard and

R Parker Allen[3] While intussusception is said to be the most common cause of intestinal obstruction in early childhood, but the greater frequency of other sources of abdominal pain may prevent a prompt correct diagnosis It is generally admitted that early and accurate recognition of this disease is the most important factor in successful treatment Dependence on typical signs of intestinal obstruction a palpable mass and blood in the stool may cause dangerous delay

The authors reviewed the records of all patients hospitalized with intussusception at the Denver Children's Hospital during the past 20 years, considering particularly the relation of time, preparatory care and method of treatment to results The review was divided into two 10 year periods

TABLE 1—RESULTS OF TREATMENT (JAN 1 1938 TO JAN 1 1948)

Total patients admitted		40
Recoveries	35	
Died after treatment	4	
Died without definitive treatment	1	
Mortality in treated patients	10 2%	
Over all mortality	12 5%	

TABLE 2—RESULTS OF TREATMENT (JAN 1 1948 TO JAN 1 1958)

Total patients admitted		137
Recoveries	132	
Died after treatment	2	
Died without definitive treatment	3	
Mortality in treated patients	1 5%	
Over all mortality	3 6%	

the former having a treatment mortality of 10% and the latter of 1 5% (Tables 1 and 2)

Time was the most important factor in prognosis Regardless of the treatment chosen nearly all patients treated within 24 hours recovered after that time there was a steady increase in mortality until 72 hours when prognosis slightly improved

Barium enema clears the indication for operation and prevents many needless explorations In the later 10 year period, the benefits of operation are attested by the low mortality, by successful bowel resection in 10 instances and incidentally by added appendectomy in 50% of the operations without apparent morbidity Operation, however, is not a universal requirement in intussusception

(3) Surgery 45 496 505 March 1959

The use of barium enema has been increasing In the earlier 10 year period, totaling 40 cases of intussusception, no conclusions can be drawn In the later 10 year period, in 137 consecutive cases, 90 patients were selected for preliminary barium enema of whom 44 or almost one third of the total were spared operation

Barium enema is most valuable in the first 24 hours after onset, it still has a place in selected patients in the second 24 hours, but after that time successful reduction is rare The procedure is usually contraindicated in the later hours, notably when shock abdominal distention, obvious small intestinal obstruction or high fever is present For operation, too, delay for proper preparation is usually mandatory when these conditions exist Radiologically controlled hydrostatic pressure followed by operation if necessary to confirm or complete reduction is the treatment of choice in selected patients

Gas Cysts of Intestine (Pneumatosis Intestinalis) According to Zuheir Mujahed and John A Evans[4] (New York Hosp-Cornell Med Center) pneumatosis intestinalis is rare in human beings but not uncommon in lower animals, especially pigs It is characterized by the presence of loculated collections of gas in the walls of any of the components of the intestinal tract or mesenteries (Fig 121) and may be found in all age groups Diarrhea, the most usual symptom in infants found at autopsy to have pneumatosis, was present in the 4 infants in the authors' series Two infants had ulcerations through which gas may have dissected into the walls of the intestine (*Figs 122 and 123*)

In adults the disease is often asymptomatic and is revealed at autopsy or as an unsuspected finding on radiography When symptomatic, it results from a complication such as partial obstruction volvulus or tension pneumoperitoneum The cysts are associated with gastric or duodenal ulcer in about 50% of cases and with all types of intestinal lesions in about 75% They have a characteristic appearance on barium contrast examination X-ray evidence of pneumoperitoneum in a patient with no symptoms or signs of a perforated viscus should also strongly suggest the condition Air cysts in the mesentery may also be identified by x ray In differen-

(4) Surg Gynec & Obst 107 151 160 August 1958

tial diagnosis, emphysematous gastritis may simulate pneumatosis intestinalis radiographically but clinically is quite different The polypous appearance of the colon in advanced

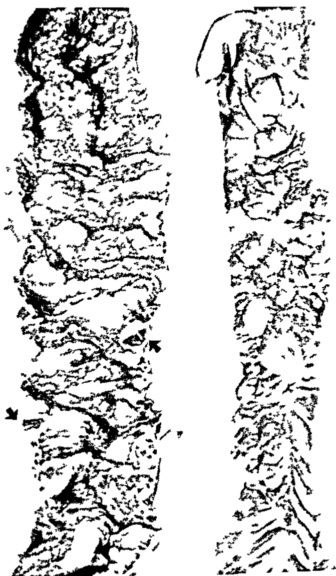


Fig 121 —Opened sections of colon showing submucosal cysts protruding into lumen Arrows indicate cysts at periphery that have been cut open by section (Courtesy of Mujahed Z and Evans J A Surg, Gynec & Obst 107 151 160 August, 1958)

ulcerative colitis may, on a barium enema, superficially resemble pneumatosis coli

In a man aged 60, pneumatosis coli was discovered at autopsy In a woman, aged 43, pneumatosis intestinalis was diagnosed radiologically but was without anatomic confirmation In a woman, aged 56, barium enema revealed the



Fig 122 (left) —Section of colon showing air cysts dissecting between submucosa and muscularis and causing bulge of mucosa into lumen
Fig 123 (right) —Section taken along border of air cyst showing absence of cyst wall and nonspecific cellular infiltration
(Courtesy of Mujahed Z and Evans J A Surg, Gynec & Obst 107 151 160 August, 1958)

characteristic x-ray appearance and cysts were visualized on proctoscopy Recognition of the condition in the last two patients prevented useless exploration

Crohn's Disease is, according to A V Pollock,[5] a chronic inflammatory disease of the gastrointestinal tract of unknown cause, usually manifested as localized thickening of the bowel wall, with strong tendency to recurrence that may be more diffuse than the original lesion Pollock observed this disease in 108 patients aged 4-69, 56% were women In only 1 was there evidence of recent active pulmonary tuberculosis X-ray or pathologic evidence of duodenal ulceration before or after treatment of Crohn's disease was present in 7 In 7 patients diagnosis of ulcerative colitis was entertained at some time during the course of the disease In many patients, symptoms were exacerbated by certain foods The commonest offending foods were fats in all forms

Grossly, the affected bowel segment, usually 6-10 in of terminal ileum, is thick, injected and juicy, with granular serosa The transition to apparently unaffected bowel is

(5) Brit J Surg 46 193 206 November 1958

abrupt The mesentery is thickened So called tubercules may be noted on the serosal surface of the bowel These represent lymphoid collections Multiple lesions were observed in 12 patients Occasionally the lesions are confined to the colon, it is in this group that the distinction from ulcerative colitis or localized diverticulitis may be so difficult Internal or abdominal fistula was present in 20 patients

Histologic changes may be summarized as patchy ulceration, which may be mucosal or deeper, lymphatic dilatation lymphoid hyperplasia, round cell infiltration and in one third of the patients, tuberculoid follicles Caseation is not found These lesions must be differentiated from ulcerative colitis localized diverticulitis and tuberculosis

Crohn s disease may be acute (history of less than 1 month), subacute (history of 1 month to 2 years) or chronic (history of more than 2 years) Most of the 37 patients with the acute disease were operated on with provisional diagnosis of acute appendicitis Abdominal pain was the commonest symptom in 39 patients with subacute disease In most with the chronic disease the history was dominated by intermittent diarrhea with mild abdominal pain of colicky type borborygmi, weight loss, anemia and lack of enjoyment of life that encouraged diagnosis of psychoneurosis in many of them

Diagnosis in the subacute and chronic group is suggested by the history In the acute group, diagnosis can seldom be made before operation Differential diagnosis has to consider the sprue syndrome intestinal lipodystrophy, ulcerative colitis, carcinoma of the right colon, benign and neoplastic strictures of the small intestine and psychoneurosis

Of 105 patients who had surgery, in 46 the lesion was resected, in 13 bypassed and in 46 the lesion was not treated either appendectomy or simple laparotomy being done Follow up over 5 10 years was conducted on 52 patients In this group the recurrence rate depended on the stage of the disease before surgery Among patients with acute disease the recurrence rate was 12%, in subacute disease, 22%, and in chronic disease, 65%

Regional Enteritis in a Large General Hospital Analysis of 29 Cases in Negroes Frederick Fitzherbert Boyce[6] in a review of records of Charity Hospital New Orleans found

(6) Surgery 44 834 843 November 1958

that 29 Negroes and 25 white patients had been treated for proved regional enteritis between 1937 and 1957 Ages ranged from 8 years in the white and 13 years in the Negro patients to 77 years in both races Seven white patients and 5 Negroes were age 50 or over No particular difference in the disease pattern was noted in the older age group Some of these patients had stormy courses, and some responded to treatment and tolerated extensive surgery quite as well as the younger group There were 3 deaths among the 12 patients age 50 or older Diagnosis may be made more difficult and surgical risk may be greater in older persons because of systemic complications

The pathologic process was essentially the same in the two races It included ulcerative and obstructive disease The ileum was affected in all patients

The case histories contributed little of convincing etiologic value Most patients presented the classic picture of regional enteritis, with abdominal pain as the outstanding feature Weight loss was notable and often occurred over an incredibly short time Fourteen white patients and 12 Negroes had no history of diarrhea

A number of patients had symptoms of obstruction, which did not prove complete in any instance, although in several the caliber of the bowel was so reduced that complete obstruction would have occurred in time

In 12 white and 14 Negro patients the duration of the disease ranged from 12 hours to 1 month, and the condition was acute in the sense that there had been no previous attacks Precipitate surgery was minimal, in this group and in the other patients in the series Whenever practical, patients were given a trial of conservative therapy, and some had already had such treatment outside the hospital

Surgical management was in line with two present day concepts (1) if the abdomen is opened on the incorrect diagnosis of acute appendicitis, the best plan is to limit the procedure to exploration, and (2) if elective surgery is undertaken, resection is the procedure of choice, short-circuiting being reserved for cases in which primary resection is contraindicated because of some specific reason such as acute obstruction or active infection

The Negroes tolerated surgery better than the whites There were 3 deaths among the 25 white patients operated

on, as against 2 among the 23 Negroes The types of surgery done included exploration, appendectomy, short circuiting, resection and multiple procedures

There were 5 known recurrences, 1 in a Negro who had exploration and 4 in white patients, 2 with appendectomy and 2 with resection

Regional enteritis is not a frequent disease in either the Negro or the white race, though apparently it is much less frequent in Negroes Good results were obtained after all varieties of surgery, including procedures such as appendectomy and exploration, which obviously could not affect the enteric disease

Chronic Regional Enteritis Survey of 126 Cases Treated at Massachusetts General Hospital from 1937 to 1954 is presented by Benjamin B Jackson[7] (Harvard Med School) The colon was involved in 43% of the patients, only 44% had involvement of the terminal ileum in its distal 15 20 cm The other 56% had enteritis above this level in the terminal ileum and 33% of this group had proximal skip areas Of the 126 patients, one fourth had skip areas

The recurrence rate was 55% when all types of therapy are averaged together Spontaneous remissions were observed in 1 6% These facts stress the great need for meticulous evaluation before any therapy is contemplated Indications for surgery are complications i e hemorrhage obstruction, perforation fistulization and right lower quadrant mass Presence of a mass is interpreted as evidence of internal fistulization or partial obstruction

Surgery was carried out in 104 patients Mortality in 57 short-circuiting operations was 7% and in 86 resections 4 5% If enteritis is localized and can be excised safely and the patient s condition permits resection is the most desirable approach If these factors do not obtain a short circuiting operation with complete division of the bowel is indicated An appendix can be excised safely in regional enteritis only if the ileocecal junction and proximal 30 cm of terminal ileum are free from disease Drainage of an abscess adjacent to loops of bowel with regional enteritis often led to a fecal fistula (24 of 30 patients) Intractable anorectal complications were most satisfactorily handled by permanent sigmoid colostomy

(7) Ann Surg 148 81 87 July 1958

Follow-up was 2-26 years and 90% of all the patients were evaluated within 1 year Resection showed good results in 60% of 86 operations When the disease was confined to the terminal ileum and right colon, excision gave good results in 70%, whereas segmental resection of other areas of small bowel produced only 50% good results Short-circuiting procedures with complete transection of the bowel showed good results in 52% of 48 operations Medical treatment alone provided good results in 35% of 22 patients

Almost all did well for 9 months to a year If the disease returned, it was likely to recur between 9 and 12 months If this peak was passed, it was often 3-4 years before recurrence was observed In 4 patients, enteritis recurred after 10 15 years and in 1, after 20 years

Apparently the most virulent form of regional enteritis occurs within the 2d and 3d decades and poorest results from all types of therapy are noted in this age group In 9 patients, chronic regional enteritis was first noted after age 50 8 of whom were treated for small bowel obstruction by short circuiting with transection or resection, all with good results One treated medically also had excellent results In the 9 patients, the disease was confined to the distal terminal ileum with occasional bridging into the cecum

The cause of chronic regional enteritis is unknown, but it has been postulated that it is due to lymphatic obstruction secondary to a toxic fatty acid in constitutionally susceptible tissue Diagnosis can be suspected from the clinical history if constantly kept in mind when abdominal disease is a question and can be confirmed by small bowel motor meal and barium enema

► [A thoughtful analysis of a relatively large series of cases with excellent follow up observations providing a well documented study This experience like our own would suggest that localized disease is best treated by resection In other circumstances a short circuiting procedure with complete division of the bowel is the procedure of choice—Ed]

Clinical Course of Regional Ileitis was studied by Solomon G Meyers, Paul E Ruble and L Byron Ashley[8] (Wayne Univ) in 100 patients Follow-up data were complete in 89 Striking clinical phenomena included onset as fever of undetermined origin, the sprue syndrome and obstruction precipitated by a foreign body Four patients had gross bowel hemorrhage, and 6 had associated chronic ul-

(8) Am J Digest Dis 4 341 351 May 1959

cerative colitis Liver cirrhosis developed in 2 patients 6 and 8 years after recognition of the disease Malignancy associated with regional ileitis was not found In 64% of the series clinical diagnosis was substantiated by tissue diagnosis An additional 21% were diagnosed by laparotomy without removal of tissue

Spontaneous or medical improvement occurred in only 20% of the patients, the rest did poorly or required surgery Modern antituberculosis therapy was given to 6 patients who showed no improvement Medical treatment is suggested for mild forms of regional ileitis Surgery is indicated when obstruction, fistula formation and intractability appear

Among 62 patients who had resection, there was no operative mortality In 11 (19%) patients, the disease recurred The authors favor resection of the diseased area over short circuiting with transection Surgery resulted in long periods of palliation or arrest of the disease in 81% of the patients Even when re resection is necessary, the patient still has a 50% chance of obtaining a good result

The usual site of recurrence was where the proximal loop of intestine had been implanted in the colon or the so called new terminal ileum This usually showed up on barium enema if pressure spot films were taken in the region of the anastomosis

The authors followed 9 patients whose regional ileitis started after age 50 5 are well after resection, 2 are well without surgery and 2 died, 1 of unrecognized obstruction and 1 of sepsis from unrecognized ileitis Regional ileitis thus resembles appendicitis in that fatality may occur from failure to recognize this disease early in the older age group

Patients who are operated on for this disease should be followed carefully medically Almost 100% of the patients have occasional diarrhea, which is usually worsened by anxiety and fatigue Diarrhea for a period after resection should not in itself be taken as indicative of recurrence because there is loss of absorbing surface after excision of the right side of the colon The regimen used preoperatively should be instituted postoperatively The body defenses may be improved sufficiently after excision of the diseased loops that involved areas left behind may clear up

Regional Enteritis II Results of Medical and Surgical

Treatment in 100 Patients, observed at the Cleveland Clinic during 1946-56, are reported by Charles H Brown and John E Daffner[9] Operaton was performed in 65, and 35 received only medical treatment Follow-up was for over a year (average 5 2 years) in 86 patients

Among the patients who received supportive and nonspecific medical treatment, 23 responded satisfactorily, 3 unsatisfactorily and 9 were followed less than 1 year Apparently antibiotics (Terramycin® in 4 and streptomycin in 5 patients) were beneficial, steroid therapy helped 5 of 10 patients and x-ray therapy 3 of 6

All patients who underwent operation had complications of regional enteritis obstruction in 30, fistulas in 25, abscesses in 13 and severe anemia or hemorrhage in 9 Indications for surgery were the complications, rather than the disease itself Results of operation were good in 32, fair in 14 and poor in 12, 5 were followed less than a year and 2 died of causes not related to regional enteritis Among 28 patients who underwent resection and in whom follow up was adequate, 23 responded in a satisfactory manner (good, 20, fair, 3)

The postoperative recurrence rate was high 63% for the entire group and 54% for those who underwent resection Of 38 patients with postoperative recurrence, 18 were treated medically and 20 underwent another operation Two were lost to follow up Response was satisfactory to the additional treatment in 31 of the other 36 patients

Results in these 100 patients warrant an optimistic approach to treatment of regional enteritis

Mesenteric Arterial Insufficiency was studied by calculation of the cross-sectional area of the superior mesenteric artery in 75 autopsies by John R Derrick and W D Logan[1] (Univ of Texas) The diameter of the mesenteric artery was measured in three places (Fig 124) at the aortic opening, at the narrowest segment, invariably 0 25-1 cm distal to the aortic opening, and 1 5 cm distal to the aortic opening where vessels were usually pliable and free from arteriosclerotic changes Measurements were obtained with the aorta in situ and after its removal The elastic tissue in the aorta resulted in a shrinkage of 8-28%, depending on severity of

(9) Ann Int Med 49 595 606 September, 1958
(1) Surgery 44 823 826 November 1958

arteriosclerosis The greater the arteriosclerotic involvement, the less the shrinkage after removal

Narrowing of the superior mesenteric of 12 86% (average 28%) was noted in 28 of the 75 aortas Arteriosclerotic narrowing consistently occurred just distal to the aortic opening

With gradual occlusion of the superior mesenteric artery, as may occur with aging, a compromised blood supply may exist, sufficient for bowel viability and for satisfactory function after light meals but incompetent or lacking in functional reserve to handle large meals requiring much work from the intestine Collateral channels may develop so that bowel viability and function are unimpaired even with heavy meals, or secondary occlusion of some smaller mesenteric vessels may result in small areas of intestinal infarction or perhaps mucosal ulcers, giving only transient abdominal symptoms Sudden complete occlusion of the superior mesenteric artery without collateral channels having been established may result in necrosis of the bowel

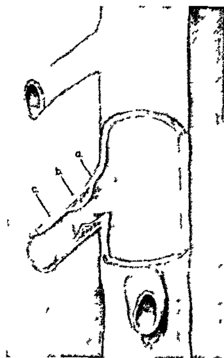


Fig 124 —Sites of measuring vessel diameter *a* aortic opening of superior mesenteric artery *b* area of greatest narrowing and *c* 1 5 2 cm distal to aortic opening (Courtesy of Derrick J R and Logan W D Surgery 44 8?3 826 November 1958)

Feasibility of sacrificing the hepatic, superior mesenteric or renal arteries and satisfactorily replacing them with other intra abdominal arteries has been demonstrated in dogs Partial occlusion of the superior mesenteric artery can now be diagnosed and the involved segment resected or bypassed It may be that exploratory operations for gallbladder disease, peptic ulcer and suspected carcinoma would not be performed if the symptom complex of intestinal arterial insufficiency were kept in mind and diagnostic means improved

The unexpected poor results of intestinal surgery in older

persons may at times be explained by arteriosclerotic enteric arterial insufficiency

Intestinal Malabsorption Following Temporary O sion of Superior Mesenteric Artery The clinical picture ously called sprue, idiopathic steatorrhea chronic je ileal insufficiency and the malabsorption syndrome result from many different pathologic lesions These m chronic pancreatitis pancreatic cancer lymphoma and reticuloses tuberculosis Whipple's disease intestin verticulosis and fistulas and results of major abdominal gery especially gastrectomy

R A Joske Munir H Shamma a and G D Drum (Harvard Med School) report 2 cases that throw ligl the physiologic mechanisms involved In each patien whom temporary occlusion of the superior mesenteri tery occurred and was surgically relieved intestinal m sorption later was shown

Case 1—Woman 52 had obstruction of the superior mese artery that lasted 34 hours from onset of pain to successful m teric embolectomy Re establishment of circulation into the su mesenteric artery was shown directly at second laparotomy the day performed because of doubt about the viability of the gut appearances were much improved and no resection was perfo Later patency of the superior mesenteric artery was demonst by aortography Two weeks after the ischemic episode gross tinal malabsorption was noted X ray changes in the small bow three occasions postoperatively closely resembled those resulting infarction of the small bowel except that they were diffuse r than segmental and corresponded well with distribution of th perior mesenteric artery The absorption defect was multipl volving fat carbohydrates and protein as well as vitamin though the different nutrients were affected in varying de

Case 2—Man 54 had end to side aortic iliac and left supe femoral homografting for bilateral thrombosis of the external arteries The intestinal arterial supply was patent at that time I een days later 9 hours after onset of severe abdominal pain la omy revealed occlusion of the celiac axis and both superior and rior mesenteric arteries with resulting ischemia affecting the gallbladder pancreas and small and large intestines The ne gallbladder was drained Removal of the thrombus atheromatou terial and thickened intima from the superior mesenteric arter sulted in good pulsatile blood flow Gray areas in the small bow came bright red and peristaltic waves reappeared Poor circul

postoperative changes characteristic of ischemia Intestinal malabsorption involved fat, carbohydrate and protein, but not vitamin B_{12}

Although thrombosis in arteries already affected by atheromas produced more extensive occlusion than in Case 1, less *ultimate functional upset was produced Survival may well* have been due to pre-existing atheroma so that some collateral circulation had developed

Mesenteric vascular disease should be considered in differential diagnosis of the malabsorption syndrome

► [This paper does show an interesting relationship between a period of temporary ischemia of the bowel and subsequent development of malabsorption syndrome Most importantly, it again demonstrates the feasibility of removing the obstructions from the superior mesenteric artery and restoring circulation to the abdominal viscera —Ed]

Intestinal Angina: Report of Case with Preoperative Diagnosis and Surgical Relief is presented by William P Mikkelsen and John A Zaro, Jr [3] (Univ of Southern California) *The patient was completely relieved from symptoms* by surgery

Man 62, had intermittent abdominal pain for 3 years The pain centered in the upper and right portions of the abdomen, developed only after meals He had also pain in the left hip, thigh and calf after walking, which was relieved by rest He had lost 53 lb On physical examination aortic pulsations were palpable in the epigastrium but terminated *2 5* cm above the umbilicus *Iliac, femoral, popliteal and* pedal pulsations were absent bilaterally There was increase in abdominal wall arterial collaterals X-ray studies of the gastrointestinal tract revealed no abnormalities

Surgical exploration of the abdomen was negative, except for the vascular abnormalities Aortic occlusion started just below the renal arteries and extended to the external iliac arteries bilaterally *The inferior mesenteric artery was occluded The superior* mesenteric artery and its intestinal branches were pulseless

After dissection of the first 4 cm of the superior mesenteric artery had been completed and its origin with the aorta cleared, a strong pulsatile blood flow developed through this previously collapsed vessel However at the ostium of this vessel and extending for 5 mm was a palpable segment of atherosclerosis Endarterectomy of the ostium was performed through the arteriotomy After closure of the arteriotomy, vigorous pulsations returned to this artery, as well as to its smaller mesenteric branches During the 2 months after operation the patient gained *3 6* kg in weight and symptoms of intestinal angina were [illegible] relieved

The syndrome of intestinal an[illegible] exist for weeks months or years before complete [illegible] the mesenteric artery occ[illegible] consistently [illegible] d by postcibal

(3) New[illegible] 260 912 914 A[illegible]

distress, which usually takes the form of cramping abdominal pain, perhaps with radiation to the back Occasionally, it occurs as a sense of distention or bloating, with constant abdominal ache The distress usually develops 15-30 minutes after eating and persists for 1-3 hours Severity and duration depend on the amount of food ingested Initially, pain may occur only after the largest or evening meal Progression of symptoms is steady Physical, laboratory and x-ray examinations are uniformly nonrevealing

Massive Bowel Infarction· Autopsy Study Assessing Potentialities of Reconstructive Vascular Surgery was carried out by Donald J Glotzer and Robert S Shaw[4] (Boston) Recent experience has suggested that in certain patients massive bowel infarction from arterial insufficiency can be satisfactorily managed by direct approach to the occluded artery, by embolectomy or thromboendarterectomy, thus expanding therapeutic possibilities in patients in whom re section would be impossible or crippling Patients have been encountered, however, in whom this approach was not rewarding, e g, when no obstructions were found in the mesenteric vessels despite bowel infarction or when ischemia persisted after early and complete embolectomy In both situations, bowel ischemia was apparently due to a factor other than organic arterial obstruction

A review of autopsy material from Massachusetts General Hospital for 1948-57 was done to determine what per centage of patients with bowel infarction could be considered anatomically salvageable by reconstructive vascular surgery and to glean clues to the pathologic physiology of infarction without occlusion Patients with pure venous infarction, occlusion of the inferior mesenteric artery alone and chronic or acute occlusion of the superior mesenteric artery without infarction were excluded

The 31 patients fitting these criteria fell into three groups 19 with fresh occlusions of the superior mesenteric artery or its branches, 3 with old occlusions and with no new occlusions demonstrated, and 9 with no demonstrably occluded major vessels to account for the infarction No unequivocal differences in the clinical findings in these three groups were found, though severity of heart disease appeared appreciably greater in the group without organic obstructions to flow Of

(4) New England J Med 260 162 167 Jan 2? 1959

the 19 patients with fresh occlusions, at least 15 had arterial obstructions that could have been corrected or were sufficiently distal to allow minor bowel resection.

The surprising frequency of massive infarction without demonstrable occlusions in this series reinforces a growing belief that such an entity does exist. One obvious phenomenon offering explanation for these cases is arteriospasm, and this was directly observed in some patients operated on. Lillehei has shown that bowel necrosis is the principal cause of the irreversibility of "irreversible" hemorrhagic shock in dogs. The combination of a fixed low cardiac output and compensatory vasoconstriction in the mesenteric circulation in severe cardiac failure might be expected to lead to critical bowel ischemia, as it does in hemorrhagic shock. Congestive heart failure and atrial fibrillation were much more common among patients who had bowel infarction without arterial obstruction than in the group with occlusions.

► [The several preceding articles, along with this study, provide increasing evidence of the importance of segmental atherosclerotic occlusive disease involving the superior mesenteric artery as a cause of ischemic disturbances of the bowel. Particularly important is the demonstration that this lesion is amenable to surgical correction in a high proportion of cases. This emphasizes the need for a better appreciation and wider recognition of this problem.—Ed.]

Tumors of Small Intestine. Between 1913 and 1957, 225 small bowel tumors were observed at Massachusetts General Hospital. Autopsy revealed 93, whereas 132 were noted at operation. R. Clement Darling and Claude E. Welch[5] studied the latter group, which comprised 46 benign and 86 malignant tumors. All 113 patients who were operated on had symptoms referable to the tumor. The major clinical patterns were those of intestinal obstruction (67%), intestinal bleeding (53%), an abdominal mass (31%) or perforation (11%). Rare symptoms included the carcinoid syndrome, the deficiency syndrome, the signs of Peutz-Jeghers disease or of multiple neurofibromatosis.

Though more benign and malignant tumors were found in the jejunum, when the area of each section of the bowel is considered, tumors are commonest in the duodenum. All the types of tumors were distributed widely, but cancer was commonest just beyond the ligament of Treitz and carcinoid tumors in the terminal ileum.

(5) New England J. Med. 260: 397-408, Feb. 26, 1959.

Correct preoperative diagnosis was made in 84% of the patients who had a roentgenologic study of the small intestine. Of the 46 patients who had benign tumors, all survived operation. The benign tumors included adenomas, lipomas, myomas, fibromas and angiomas. Symptoms were present in 28 patients (Fig. 125). Of the 86 patients with primary small bowel malignant tumors, all but 1 were symptomatic. These tumors, in order of frequency, included carcinoma



Fig 125—Massive hemorrhage due to leiomyoma of lower jejunum in man, 60 Diagnosis of duodenal ulcer was made by x ray study soon after onset of massive rectal bleeding No lesion was noted in small intestine After 19 transfusions, exploration was done and leiomyoma was resected Convalescence was uneventful despite total of 31 transfusions (Courtesy of Darling, R C, and Welch, C. E New England J Med 260 397 408, Feb 26, 1959)

(32 patients), malignant lymphoma (29 patients), carcinoids (15 patients) and leiomyosarcoma (9 patients).

In the 54 patients with malignant lesions who had resections for cure before 1953, 16 (30%) died postoperatively; 47% of these survivors were living and free from disease 5 years later.

Though there were many exceptions, several diagnostic features of interest may be cited. Tumors found incidentally at laparotomy are nearly always benign. Obstruction is usually chronic and remittent (when acute small bowel obstruction is due to intussusception in adults, a tumor of the intestine is involved in about half the patients and the lesion usually is benign). Intestinal bleeding is common with all tumors except carcinoids; bleeding was encountered in only 2 (13%) of the 15 patients with carcinoids. A palpable mass nearly always indicates a malignant tumor (when the mass is tender a lymphoma should be suspected). Perforation is

common with lymphoma and sarcoma (it is rare with cancer and was not encountered with carcinoid or benign tumors).

Malignant Tumors of Small Intestine are rare, accounting for less than 1% of all gastrointestinal cancers The 1-ft segment of the stomach produces 65 times as many cancers as do the entire 23 feet of the small intestine

Malcolm B Dockerty[6] (Mayo Clinic) summarizes clinical and pathologic data on 63 surgical patients, average age 48, with jejunal and ileal carcinomas of "type ordinaire," 30 with carcinoids, 41 with leiomyosarcomas and 33 with lymphosarcoma Preserved gross specimens or biopsy tissues were available for study from all

The clinical syndrome was of three types, according to whether the predominant manifestation was anemia, intestinal obstruction or perforation Clinical examination revealed a mobile abdominal mass in 50% Resection permitted hope of cure in about two thirds Surgical mortality was 22% Palliative resection was done in the face of hepatic metastasis in 9 patients and ovarian involvement with Krukenberg's tumors in 3 In the others, local fixation was such that only short-circuiting operations were feasible or surgery was contraindicated Five-year survival was achieved in 25%

Of 54 resected lesions, 36 were of the small, stenosing, napkin-ring type, with minor mucosal ulceration, but pronounced tendency to obstruct, 11 were of the irregular ulcerative variety, tending to spread longitudinally rather than circumferentially, and 7 were polypoid and intussuscepting All three types were associated with some obstruction, but perforation was a feature of the first two only Lymph node involvement was proved in about 60% of the patients with resection and was probably present in all who had only palliative operations Microscopically all the lesions were adenocarcinomas with anaplasia midway between that observed in gastric and in colonic growths

Metastatic lesions were found in 13 of the 30 patients with carcinoid The salient features in this group were (1) the patients were old, (2) lesions were symptomatic, sometimes for a long period, (3) curative or at least palliative opera-

(6) Canad M A J 79 967 972 Dec 15 1958

tion could be performed in about half the patients despite metastasis, and (4) all lived for long periods postoperatively All the tumors were small The mass that is felt in the patient with a small intestinal carcinoid is the metastatic lesion Multiple tumors, probably representing multifocal points of origin, were noted in about one third of the patients In 1, a 3 ft segment of ileum harbored no less than 100 separate, distinct growths Lymph nodes were the favored sites for secondary deposits, but the liver was involved in 5 of 13 patients

In 45 years, 76 leiomyosarcomas have been observed, 41 of which were malignant Severe intestinal bleeding was present in 50 patients, with no particular difference between malignant and benign cases A movable mass was palpated in 40% X ray localization was possible in 23 of 38 patients examined, but the nature of the lesion could not often be predicted Preoperative diagnosis was peptic ulcer in 17 patients All benign tumors were successfully removed, of the 41 patients with leiomyosarcoma in 5, partial or palliative resection was necessary and in 2, biopsy alone was possible Surgical mortality was 10% In 13 of 26 patients, survival exceeded 5 years, but 3 had recurrent tumors Gross evidence of metastasis was observed in 9 of the 41 patients with malignant tumors (in the liver in 4)

Lymphosarcoma accounts for about 25% of primary small intestinal malignant tumors, and heads the list of those affecting children All 33 patients with this lesion were under age 20 or over age 40 All had gastrointestinal symptoms of fairly short duration, 31 had abdominal pain, usually of colicky type A palpable mass was noted in 60% Diagnosis was usually made at pathologic examination during operation Treatment was by resection followed by x-ray therapy in 27 who survived operation Two were lost to follow up and 8 of the remaining 25 lived 2 years or more Recurrences usually appeared within 2 years, but 1 died of recurrent tumor 8 years after resection Ten year salvage was below 10%

Is Appendicitis Decreasing in Frequency? According to Kenneth B Castleton, Charles B Puestow and Dean Sauer, there is strong evidence that in the past 15 years, incidence of acute appendicitis has decreased Though it has been known for some years that the mortality rate from appendicitis has been decreasing, it has been assumed that this is due to use of antibiotics, better diagnosis, expert anesthesia, use of blood and other fluids, etc It now appears that part of this decreased mortality is due to decreasing incidence of the disease This decrease is not accounted for by a more critical diagnostic approach to the disease, as fostered by hospital tissue committees because not only has incidence of appendectomy decreased but the actual number of proved cases of acute appendicitis has substantially decreased as well The apparent decreased incidence of the disease and decreased frequency of appendectomy are apparently not due to increased frequency of the operation in suburban and rural hospitals

It is interesting to note the great change in the ratio of appendectomies to the total number of surgical patients in a hospital In 1941, appendectomy made up about 10% of all surgical procedures, but it now constitutes only about 2% This change is probably due only partially to the decreasing incidence of appendectomy Most of it is more likely due to the greatly increased frequency of other, newer types of surgery that have been introduced in this period

The cause of the apparent decreasing frequency of the disease is not clear Better nutrition better dietary habits and the widespread use of sulfonamides and antibiotics as possible preventive measures are some of the factors that come to mind, but there is no scientific evidence that these are responsible The whole picture may be simply one of cyclic decrease, as is noted in some other diseases that increase and decrease in cyclic manner without apparent cause

Acute Appendicitis Analysis of Complications in 551 Patients is presented by J L Ponka (Bay City, Mich), H L

( ) A M A Arch Surg 78 794 801 May 1959

Shields and D M Evans[8] (Henry Ford Hosp) According to the *Vital Statistics of the United States* 2,044 persons died of appendicitis in 1954 and 2,093 in 1955 Most of these persons were in the younger age groups

The authors studied data on 551 patients with acute appendicitis who were treated by appendectomy during 1948 through 1952 There was 1 death due to pulmonary embolus Incidence of complications was 16 46% peritonitis, 7 3%, abscess formation, 3 6%, wound infection, 2 5%, hernia, 0 9%, postoperative ileus 0 72%, phlebothrombosis 0 9%, pulmonary emboli, 0 36%, and subdiaphragmatic abscess, (0 18%) The complications, except phlebothrombosis and pulmonary emboli, were directly due to extension of the infection beyond the confines of the appendix In treatment of the complications, the antibiotics have proved most valuable Nevertheless, antibiotics did not eliminate many of these complications Drains, Levin tube, Miller Abbott tube and blood transfusions were valuable adjuncts in controlling the infection after it had extended beyond the appendix and resulted in localized abscesses and caused secondary ileus

► [An increasing number of strains of bacteria are becoming resistant to antibiotic and chemotherapeutic agents Proper surgical management remains the fundamental weapon against the complications of appendicitis —Ed]

THE COLON AND RECTUM

Further Experiences with Treatment of Imperforate Anus are reported by Donald Brayton and William J Norris[9] This study was based on 93 patients (58 boys), who were treated at the Los Angeles Children's Hospital between 1948 and 1955 Distribution according to type was type I, 7 patients type II, 11 type III, 74 and type IV, 1 Accessory anomalies were present in 50 (53 8%) patients, mostly in type III Prematurity was an additional hazard in 13 patients (14%)

Of the 7 patients with type I imperforate anus, 6 were treated by dilatation, and 1 by division of an annular band at the anorectal junction, with poor result due to stricture

(8) J Michigan M Soc 58 415-416 March 1959
(9) Surg Gynec & Obst 107 719 726 December 1958

Of the 7, 2 died, 1 of associated anomaly and 1 of pneumonia 10 days after discharge

Laparotomy was performed in the 1 patient with type IV anomaly, a clamp was thrust upward from below, breaking the membrane separating the anal pouch from the rectum This was followed by dilatations with good result

Of 9 boys with type II imperforate anus, 3 had rectoperineal fistula All were treated by excision of the thin membrane separating the anus from the exterior In 3 patients, sutures were placed between the anal mucosa and skin Results were good in 8 and poor in 1 in whom anal stricture developed The fistulas all closed spontaneously with establishment of the anal outlet One patient died of associated anomaly and 1 of intercurrent disease at age 1 Diagnosis of the relatively rare type II anomaly rests on the extreme thinness of the membrane closing the anus If there is any appreciable thickness, the condition is probably a low-lying type III anomaly and requires further evaluation

Among the 74 patients with type III imperforate anus, 32 of 44 boys had a primary definitive operation perineal proctoplasty in 10, abdominoperineal replacement in 20, and dilatation, rectoperineal fistula in 2 Six were treated originally by sigmoid colostomy Primary definitive operation was performed in 24 of the 30 girls with type III anomaly, 5 were treated first by sigmoid colostomy Results indicated that definitive surgery for type III imperforate anus after initial colostomy is less likely to be successful than definitive surgery primarily Of the 74 patients, 20 died In 2 of these no operation was performed Death occurred after primary operation in 5, after secondary operation in 3, from associated anomalies in 4 and from operation for associated anomalies in 6

Of the entire 93 patients, 24 (25 8%) died, 14% due to associated anomalies, 9 (9 7%) due to primary and secondary surgical mortality and 2 (2 1%) because no operation was performed Incidence of actual or potential fistulas in type III imperforate anus was higher than previous statistics have indicated and probably approaches 100% in both sexes Less than one fourth of the rectourinary and high rectovaginal fistulas could be diagnosed preoperatively

New Treatment for Pruritus Ani Clifford C Wilson[1]

(1) South M J 52 96 97 January 1959

(Kansas City, Mo.) emphasizes the efficacy of corticosteroids as "near specific" preparations for anal and anogenital pruritus. Their introduction has made all other treatment obsolete. Radical surgery, such as the Ball operation, is no longer indicated. Surgical treatment of associated disease, however, such as hemorrhoids, fissures, fistulas and crypts, is still in order and should be done before other treatment is started. If the lesion associated with pruritus ani is not removed, other treatment is only palliative.

Wilson recommends fludrocortisone, because its anti-inflammatory action is 10-25 times that of hydrocortisone and it also has a strong antipruritic effect. Florinef®-S lotion and ointment is fludrocortisone acetate with neomycin and gramicidin added; recently Mycostatin®, a fungicide, has also been added. These combined preparations are effective in 90% of the patients with pruritus ani. For the 10% who do not respond, Perazil® cream or Prantal® cream, 2%, is usually effective.

Retrograde Operation for Prolapsing Hemorrhoids was developed and used on over 500 patients with satisfactory results by Mark M. Marks[2] (Menorah Med. Center, Kansas City, Mo.).

TECHNIC.—With the patient in the lithotomy position, low spinal or Pentothal® anesthesia is given. Crypts are probed for and incised. Hemorrhoids are usually removed counterclockwise. The primary hemorrhoid on the left lateral wall is first isolated with the speculum, grasped with a Kelly forceps and everted to the outside. A second clamp is placed above on the redundant or normal mucosa and drawn downward until it is taut. The speculum is removed. A suture of 000 chromic catgut on a round tonsil needle is passed through the upper pole of the tense mucosa and tied with 3 square knots. The suture may be placed 1-2 in. above the hemorrhoid itself, depending on the degree of redundancy. The mucosa down to the hemorrhoid is constricted by a running or lock stitch. The hemorrhoidal varix is adequately exposed by lifting the free end of the suture and can be cut free from its bed with scissors in a retrograde manner to the mucocutaneous line. The arrested suture is then continued caudad, with closure of the severed edges of the mucosa, and is tied just above the junction of the mucosa and the anoderm. The dissected hemorrhoid is left attached to the skin for the present.

The dependent external hemorrhoidal plexus and overlying skin are caught with an Allis clamp and dissected upward with scissors to include a strip of anoderm and the hemorrhoid that was previously removed. Additional subcutaneous varicosities can easily be exposed for excision by inserting the index finger into the anus and lifting the

(2) South. M. J. 51:1168-1172, September, 1958.

levator *shelf Bleeders are tied off as required Lateral skin wounds* are closed with interrupted subcutaneous sutures of plain catgut

The next major hemorrhoid to be removed is on the anterior rectal wall and is treated in the same manner, except that in females the

ing, the dissection can be made in steps ahead of the closing suture Reduction of the size of the rectocele in women can be demonstrated by barium filling before and after operation The right posterior lateral hemorrhoid is also treated by high ligation, dissection and closure

Patients with secondary hemorrhoids are treated by radial incision and removal of submucosal veins The mucosal wounds are closed with interrupted plain sutures

Hemorrhoidectomy—Need for Sound Appraisal According to F John Lewis[3] (Chicago), current medical literature carries few articles on hemorrhoidectomy, and these concern only technic There seem to be no attempts to study results of the operation or to compare effectiveness of operative with nonoperative treatment In individual hospitals, the operation may also escape the attention it deserves If hospital committees try to evaluate use of the operation, *they find that the pathologist, generally trusted in these* matters, is of no help Microscopic examination of a bit of mucosa and some dilated veins can have little pertinence to the issue, for such a specimen could be removed from almost any middle aged patient willing to have the operation

The crucial question is whether the operation is being done for good reasons Indications for the operation should not be broadened to include all patients with symptomatic hemorrhoids who come under the care of an occasional surgeon Any surgeon not manifesting a primary interest in proctology who does a large number of hemorrhoidectomies is a fair target for criticism Many of his patients with hemorrhoids could doubtless be treated successfully by conservative methods alone They may need nothing more than some good advice about personal hygiene and perhaps a few days of bed rest Careful soap and water cleansing of the anus after each *bowel movement is effective in clearing the* chronic infection that is generally recognized as the usual cause of painful hemorrhoids If the hemorrhoids are large they shrink rapidly when the favorable hemodynamics provided by *bed rest are added to a regimen of cleanliness* Is

(3) Surgery 44 431 432 August 1958

it possible that the painstaking care given to these patients after a hemorrhoidectomy to obtain rapid convalescence would cure most of them without an operative procedure? Comparison of this course of therapy with the operative treatment would doubtless be enlightening

Rebuttal to "Hemorrhoidectomy—Need for Sound Appraisal," is made by Robert Turell[4] (New York) with reference to a recent editorial on the subject Most cases of symptomatic, small or moderate-sized internal hemorrhoids neither warrant nor require hemorrhoidectomy with the attendant remote, but potential, risk incident to an anesthetic and surgical procedure and the loss of work hours Most, if not all, of these patients can be satisfactorily treated by the ambulatory injectional method However, patients who have large internal or internoexternal (mixed) hemorrhoids with pain, protrusion or bleeding, do require surgery and are but temporarily helped when treated by conservative methods alone

It is doubtful that chronic infection causes hemorrhoids or "painful hemorrhoids" Hemorrhoidal tissue removed at operation and that obtained from rectums extirpated for cancer, as well as that removed at autopsy from subjects with nonintestinal disease, invariably shows the same histologic picture—dilated veins with variable degrees of inflammatory reaction but no evidence of infection

Conventional periodic digital explorations or examinations, or the special topical application of medications, such as vitamins and chlorophyll, to anorectal wounds after the open technic *of hemorrhoidectomy, do not appear to influence* or expedite the healing process of the wounds In controls whose postoperative wounds were left practically undisturbed healing was just as effective The maneuvers described are performed regularly because of custom, habit and tradition, or their use is dictated by the dire need resulting from a poorly conceived new technic or a poorly executed initial orthodox hemorrhoidectomy

Frequent digital or instrumental anal dilations and drugs are no substitutes for basic concepts and sound surgical principles The author advocates that surgical treatment of lesions of the sensitive anorectum as any other type of operation, should be based on Halsted's principles

(4) Surgery 44 959 961 November 1958

Anorectal Plastic Operation for Fissure and Stenosis and Its Surgical Principles. Charles Evans Pope[5] (Evanston, Ill.) describes a method, used routinely for 11 years, which offers ease of technic, relative freedom from postoperative pain, rapid healing and almost complete absence of postoperative complications.

TECHNIC.—Reverse Trendelenburg position (Fig 126 A) is used and the anus and operative field are exposed by modified Bearse taping. Posterior midline incision is made from the anal orifice half

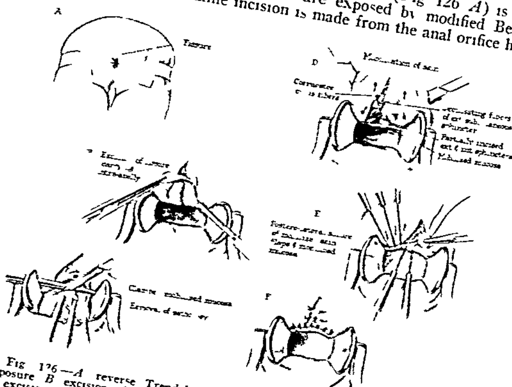


Fig 126.—A reverse Trendelenburg position with modified Bearse elastoplast exposure B excision of diseased tissue including crypts fissure scar and mucosa. C excision of same superior to dentate margin D mobilization of skin perianally also showing partial posterior sphincterotomy E suture with silk of mobilized skin and mucosa with catgut at dentate margin level F completed plastic operation with clamp ligature hemorrhoidectomy to follow (Courtesy of Pope C E Surg Gynec & Obst 108 249 252 February 1959)

way to the coccyx and continued intra anally to just above the posterior anorectal line or dentate margin. All diseased tissue including crypts fissure scar and mucosa are excised (B) by appropriate extension of this incision. Normal purse stringing of the mucosa into the folds of Morgagni permits lateral spread of the midline mucosal incision as the anal passage is dilated by speculum and midline incision. A width of 3 cm is mobilized by blunt dissection and transversely fixed by hemorrhoidal clamp about 1 cm below the point of mobilized dissection (C). All crypts and papillae are excised and anal ducts or glands are thereby laid open or excised. The skin is mobilized perianally (D) to within 2 cm of the coccygeal end of the

(5) Surg Gynec & Obst 108 249 252 February 1959

midline wound, over the internal and subcutaneous external sphincters and finally to the upper pole of the wound superior to the dentate margin Perianal mobilization includes subcutaneous fat, but anally and intra anally the incision is made through areolar tissue with severance of corrugator cutis fibers from the conjoint longitudinal muscular septum and some fibers from both sphincters Posterolateral suture of the plastic flap and mobilized mucosa is then carried out Right and left posterolateral suture of the skin and mucous membrane is begun at each outer angle of the skin and mucosal juncture (*E*) with 00 silk After careful Lembert suture of the mucosa a relatively large bite of anal skin is taken Three sutures may suffice on either side provided the posterior gaping wound is fairly well closed except for a midline strip of open wound Each successive suture is placed close to the last suture, but relatively much farther apart and outward on the skin Interrupted intervening through and through sutures of the skin and mucosa may be taken if bulging or lipping is present with inexact approximation of tissue One or two external sutures of skin to the wound are taken near the midline postanally (*F*) These are tied tightly to permit their delayed slough within 4 8 days Suture of free mucosa with 00 nontraumatic catgut by interrupted Lembert sutures is then taken at or slightly above the dentate margin level The final stage is hemorrhoidectomy, preferably by clamp and ligature

Treatment of Complete Prolapse of Rectum by Rectosigmoidectomy (Auffret-Mikulicz-Miles Procedure) was carried out by William B Gabriel[6] (London) in 145 patients (127 females) Seven required more than one rectosigmoidectomy 6 had one repetition after 8 20 years and 1 required operation three subsequent times Two thirds (89 of 127) of the women were over age 60 and 18 were 80 or over Of the 89 elderly women, 32 (36%) were unmarried, suggesting that childbearing is not necessarily a major cause of rectal prolapse

The surgical technic varies according to the length of the bowel to be removed Cohn's method of approximating the margins of the puborectalis muscles from below is a useful addition and was used in 70 women without complications Fine braided stainless steel wire sutures were used

Good results were obtained in 83 of 131 patients operated on before December, 1956 Besides, patients who ultimately had relapse and were treated by Thiersch's operation or by repeat rectosigmoidectomy have done well, so that total good results were obtained in 109 (83 2%) Of 19 patients with prolapse treated by Thiersch's operation, all are well and are re examined regularly In 10, the original wire is in

(6) Dis Colon & Rectum 1 241 250 July Aug 1958

situ, in 4, for 3 years or more, the longest period being 10 years With a Thiersch wire in satisfactory position, a patient can resume full normal activities and should continue with exercises for contraction of the sphincters and pelvic floor In 9 patients, the Thiersch wire broke and had to be removed and replaced 7 patients needed 1 replacement, 1 needed 2 replacements, and 1 needed 4 The 7 who had repeat rectosigmoidectomy have done well and there seems to be no particular difficulty or danger in these operations The cause of recurrences after rectosigmoidectomy is obscure, but it must arise from further stretching or elongation of the pelvic mesocolon Persistent irritability of the bowel and unwise straining at defecation is probably a factor In some, this tendency may have been aggravated by failure to regain normal bowel rhythm and by unwise use of laxatives Liquid paraffin should be especially avoided by patients who have been operated on for prolapse

Of the 145 patients, 2 died 1, a woman, aged 68 died early in the series, probably of pulmonary embolism and 1, a woman, aged 81, of cardiac failure due to coronary occlusion

Experimental Evaluation of Fecal Continence—Sphincter and Reservoir—in Dog Total fecal continence consists of two components sphincter continence and reservoir continence with alteration of fecal consistency and volume Mitchell Karlan Richard C McPherson and Robert N Watman[7] (Ohio State Univ) investigated both components and found that the reflexes invoked in voluntary sphincter function are maintained by preservation of a short length of distal rectum, even when denuded of mucosa This theory implies the presence of adequate receptors in the retained muscular wall of the short rectal stump This was true in all animals in which such a stump was preserved Sphincter continence was lost with removal of the total rectum indicating the vital need for the receptor organs in the rectum Those of the anus and sphincter alone were inadequate

Absence of a suitable reservoir did not permit adequate control of defecation because of the fluidity and volume of the stool The dogs had many movements and were conscious of frequent defecatory impulses When a reservoir was constructed the reverse occurred The dogs manifested severe obstipation The S type ileal pouch manifested

(7) Surg, Gynec & Obst 108 469 473 April 1959

grossly inadequate motility Presence of one antiperistaltic segment was apparently enough to interfere with the normal intestinal activity of the isoperistaltic limbs Thus, a type of pouch obstruction developed simulating megacolon

Construction of an isoperistaltic ileal reservoir resulted in a structure of good capacity and also of adequate coordinated propulsive activity to empty when necessary An isoperistaltic double ileal pouch can serve as a satisfactory rectal ampulla for reservoir continence It is tempting to consider the application of such a technic in patients undergoing total coloproctectomy for ulcerative colitis or multiple familial polyposis The procedure was performed in a woman, aged 29, with multiple familial polyposis of the colon with equivocal results The technical difficulty far exceeded that experienced in the dogs Whether the operation is clinically useful is still problematic

Radiation Injury to Sigmoid and Rectum Bentley P Colcock and Alan Hume[8] (Lahey Clinic) reviewed data on 41 patients with serious injury to the small bowel and sigmoid or rectum after pelvic radiation Severe proctitis was present in 22, sigmoiditis in 3, rectal stricture in 12 and sigmoid stricture in 4 There were 5 instances of necrosis of the small bowel and 3 fistulas between the bowel and genitourinary organs Time of onset of symptoms was not related to elimination of the pelvic cancer by radiation Average duration between the first treatment and onset of symptoms of proctitis was 4 months in the survivors and 24 months in those who died of recurrent disease The difference may be accounted for in part by the fact that secondary supervoltage therapy was more widely used in the latter group Significant intestinal damage was evidenced by persistent symptoms usually occurring toward the end of therapy or shortly thereafter In patients receiving a secondary course of radiation the symptoms could occur at any time Onset of proctitis was evidenced by diarrhea, rectal bleeding and pain In some diarrhea may be severe and lead to symptoms of electrolyte imbalance, such as notable decrease in serum potassium Bleeding may be so severe as to require abdominoperineal resection

The authors developed this treatment plan if symptoms are not completely controlled within 2 weeks after onset,

(8) Surg Gynec & Obst 108 306-312 March 1959

the patient should be hospitalized. Adequate proctosigmoidoscopic and pelvic examination is essential, using anesthesia if pain prevents adequate examination. Barium enema study is made as soon as rectal discomfort has subsided sufficiently. The bowel management program consists of a bland, low-residue diet, sedation, antispasmodics, intestinal antibiotics, hydrocortisone enemas, bed rest and general supportive measures.

If no significant improvement occurs after 2 or 3 weeks of hospital treatment, proximal colostomy should be established. This should also be considered if significant bleeding occurs and persists or if symptoms recur after conservative treatment in the hospital.

Symptoms of obstruction of the small intestine may result from adhesions or stricture of the ileum secondary to radiation treatment of a pelvic malignant tumor. Sudden perforation of the ileum, sigmoid or rectum may occur months or years after treatment. Abrupt onset of peritonitis in any patient who has received radiation therapy to the pelvis should be promptly investigated by laparotomy.

Rectourinary Fistula: Principles of Management and Technic of Surgical Closure. Willard E. Goodwin, Roderick D. Turner and Chester C. Winter[9] report observations on 22 patients and present a technic somewhat similar to that described by Weyrauch and by Wilhelm and derived from the original method described by Young which was used without failure in 9 patients who had closure of postprostatectomy rectourinary fistula It is simpler and more direct than previously described technics.

Principles of the method are (1) wide perineal exposure, (2) transection of the fistula, (3) development of multiple layers on both the urinary and rectal side of the fistula, (4) two-layer closure of urinary fistula with suture lines at right angles to each other, (5) two-layer closure of rectal fistula with suture lines at right angles (Figs. 127 and 128), (6) mobilization of rectum downward and bladder upward to separate the suture lines, (7) interposition of levator ani muscles between urinary tract and rectum and (8) adequate postoperative urinary drainage via suprapubic and urethral catheters. Adequate preoperative antibiotic treatment is extremely important. Although colostomy was used in some

(9) J. Urol. 80 246-254, October, 1958

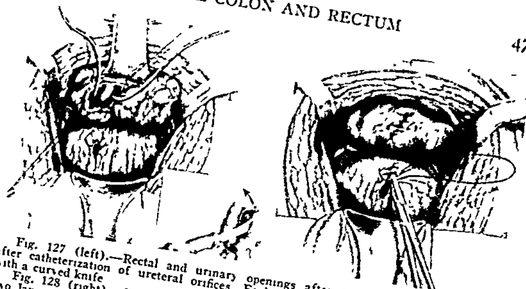


Fig. 127 (left).—Rectal and urinary openings after transection of fistula and after catheterization of ureteral orifices Each orifice is developed into two layers with a curved knife

Fig. 128 (right) —Two-layer closure of each side of fistula. Bladder closed with two layers of interrupted catgut sutures placed at right angles to each other and rectum being closed with continuous catgut suture for mucosal layer Second layer of inverting, interrupted sutures will be placed through fascia and muscularis of bowel

(Courtesy of Goodwin, W E, *et al* J Urol 80 246-254, October, 1958)

patients, it is not always necessary. Patients being prepared for this operation receive the same meticulous bowel preparation as for ureterosigmoidostomy.

Catheters are usually left in for at least 2 weeks. The patient is allowed full ambulation and may receive a preparation of dioctyl sodium sulfosuccinate to promote soft stools. The drain is removed on the 1st or 2d postoperative day.

Pseudo Hirschsprung's Disease, or megacolon and obstipation, according to Mark M. Ravitch[1] (Johns Hopkins Univ.), is seen in four types of patients: (1) organically normal children in whom the condition has a psychogenic basis; (2) mentally defective children; (3) children with organic anal obstruction after corrected imperforate anus; and (4) congenital cretins.

In children with psychogenic constipation, in contrast to those with true Hirschsprung's disease, symptoms do not appear at birth, encopresis is common and the barium enema shows no narrow distal segment. It is far commoner than the organic disease due to absence of ganglion cells of the myenteric plexus Constipation usually begins in the 3d or 4th year or later. The most superficial questioning readily elicits rich evidence of tension, hostility and neurotic difficulties in parents and child. X-rays show a large redundant

(1) Ann Surg 147 781 795 June, 1958

atonic colon which may well mimic Hirschsprung's disease in size and quantity of retained stool Proper studies show that the dilatation involves the rectum and reaches the anal canal Diagnosis can usually be made on history alone

Parents and child are told jointly that treatment is a matter of habit training, that it can be corrected by proper training, that there is no organic abnormality of the bowel and that operation cannot be considered They are admonished that strict adherence to the precise regimen prescribed will be insisted on Usually, successful treatment can be carried on an outpatient basis

As many large tap water enemas are given initially as are required to empty the colon completely Parent and child are instructed that for the first 2 weeks daily at a definitely appointed time, a 1 qt enema of warm tap water is to be given whether the child has had a spontaneous bowel movement in the interim or not For the next 2 weeks, the child goes to the toilet at precisely the same time that the enemas have been given If there is a large and copious stool after 10 minutes, no more need be done If there is no stool or only a small one an enema is given Usually within 2-4 weeks the child is evacuating daily without an enema Once regularity is apparently firmly established mother and child are instructed to forget all about the problems of defecation No drugs of any kind are used

A similar regimen is used in mentally defective children and ultimately may establish the kind of automatic bowel training which can be obtained even with abdominal colostomies In children with megacolon and obstinate constipation associated with organic anal obstruction an enema regimen is combined with dilatation of strictures or anoplasty The basic defect however may require indefinite continuance of treatment

In newborns and infants in whom diagnosis of cretinism is not readily apparent abdominal distention and obstipation may be presenting symptoms The clinical picture may resemble that of Hirschsprung's disease Constipation and abdominal swelling respond dramatically to thyroid extract in these patients and x rays show reversion of changes in the colon and rectum

Rectal Biopsy in Diagnosis of Hirschsprung's Disease Experience with 100 Biopsies According to Orvar Swen

son, John H. Fisher and Gherardo J. Gherardi[2] (Tufts Univ.), rectal biopsy provides the sole means for establishing diagnosis of Hirschsprung's disease in most infants and in some children with atypical histories and nonspecific roentgen findings. In 100 consecutive biopsies in patients considered possibly to have Hirschsprung's disease, positive diagnosis was made in 38 All 38 were operated on, and in all the operative specimen showed the typical lesion of Hirschsprung's disease

TECHNIC —Patients are prepared with rectal irrigations only. General anesthesia is administered The patient is turned on the side and

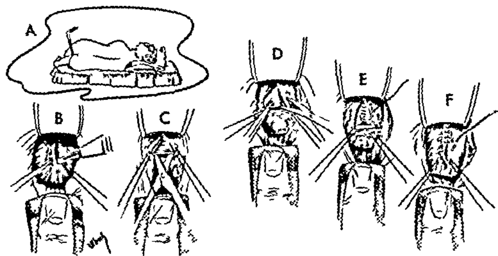


Fig 129 —*A*, position of patient for rectal biopsy *B*, lateral rectal wall incised 2 cm [illegible] care taken to include circular and longitudinal fibe[illegible] f muscle wall is removed for histologic study *E* [illegible] sutures *F* mucosa approximated with chromic cat[illegible] O, *et al* Surgery 45 690 695, April, 1959)

the hips are flexed (Fig 129, *A*). The perineum and rectum are prepared with pHisoHex® and aqueous Zephiran®. A gauze sponge is placed in the upper rectum to prevent feces from contaminating the operative field A Sims retractor helps to expose the rectal wall. The biopsy site is chosen on the lateral wall, 2 or 3 cm above the mucocutaneous margin Traction sutures of fine silk are placed on each side of the biopsy site to aid in maintaining the rectal wall in the field (*B*) The mucosa is incised for 2 cm and by blunt dissection separated from the muscular layer A triangular piece of muscular wall, 5×10 mm, is removed, care is taken that the circular and longitudinal layers are included in the biopsy material (*C-D*).

The defect in the rectal wall is closed with interrupted sutures (*E*). A layer of 4-0 silk is used to close the muscular coats and 4-0 chromic catgut is used for the mucosa (*F*) Hemostasis is complete with this technic No postoperative precautions as to diet or bowel management are observed Antibiotics are not given, and the patient is dis-

(2) Surgery 45 690 695 April 1959

charged the day after the biopsy *One advantage of taking the biopsy* several centimeters above the mucocutaneous line is that it is in the segment of bowel to be removed if the operation for Hirschsprung's disease is performed

The biopsy carried no mortality Morbidity was negligible, 1 patient early in the series was returned to the operating room for additional hemostatic sutures No perirectal infections, fistulas in ano or disturbances of anal continence occurred Resection for Hirschsprung's disease was occasionally performed the same day as the biopsy or several days later, depending on the patient's condition

► [This method of diagnosis is a distinct aid in patients without classic clinical and roentgenologic features Unfortunately, its value is in direct *proportion to the experience of the pathologist in interpreting the state* of the innervation of the bowel wall —Ed]

Volvulus of Cecum: With Review of Recent Literature and Report of Case Occurring as Postoperative Complication H Sheffield Jeck[3] (Kennedy Hosp, Memphis, Tenn) collected from the literature reports of 62 cases proved at operation, in this series, 5 patients died of advanced gangrene of the cecum and 3 of unrelated causes Jeck reports an additional case

Man, 58, on the 3d day after a relatively simple repair of a recurrent inguinal hernia on the left side had marked distention of the lower abdomen, with discomfort For many years, he had had resistant constipation that required frequent laxatives for relief and had also noted occasional bloating, sometimes relieved by bouts of diarrhea and passage of considerable gas Flat x ray films of the abdomen ... the right lower quad ... the rest of the colon ... nset of symptoms, exploratory laparotomy was done and diagnosis of volvulus of the cecum was established

The inciting cause of volvulus may be anything which disturbs an already mobile cecum—one which has a long mesentery and is therefore not well secured in the right lower abdominal quadrant Pregnancy, labor, violent peristalsis, intra abdominal tumors, cysts, fecaliths, foreign bodies, congenital bands and strictures, inflammatory conditions of the colon and habitual constipation have also been implicated A large, dilated loop of bowel, identified pre- or postoperatively as the cecum, has been found in all the abdominal quadrants

In patients without gangrene, derotation with cecostomy

(3) Am J Surg 96 411 414 September 1958

and/or cecopexy will suffice to relieve obstruction and distention and fix the cecum in the right lower quadrant, thus preventing further twisting In those with doubtful or frank gangrene, resection of the right colon with primary ileum transverse colon anastomosis, a Mikulicz type of resection or even exteriorization of the involved bowel is the procedure demanded

Antibiotics for Colon Surgery. Isidore Cohn, Jr[4] (Louisiana State Univ) reports on experimental work that showed the protective value of antibiotics in promoting the healing of a colon anastomosis placed under severe strain, which led to study of the relative value of various agents for preoperative intestinal antisepsis Evaluation by standardized methods of 28 agents for intestinal antisepsis permitted their classification into recommended and less satisfactory groups All drugs recommended for general use for intestinal antisepsis are combinations of neomycin with another poorly absorbed agent

Clinical trial of a triphasic antibiotic-administration program was undertaken in 200 patients who had colon surgery The three phases included preoperative antibiotic preparation intracolonic instillation of antibiotic powder at time of operation, and postoperative intraluminal antibiotic administration

No side effects occurred in 127 of the 163 patients who received Achromycin® neomycin preoperatively, 47 reactions occurred in the 36 patients who had side effects Only 3 patients had to discontinue treatment because of these reactions Enterocolitis was not observed Antibiotic powder was instilled into the colon in 88 who had elective surgery and in 3 who had emergency procedures Because there is little need for local therapy when no anastomotic or colotomy suture line is returned to the peritoneal cavity, this form of therapy was not used often after colostomy was established

Use of a plastic tube for postoperative drug instillation was the major clinical innovation resulting from the experimental work, and was used in 67 patients In 62 patients there were no complications related to use of the tube In 2, the tube came out of the bowel, in 2, the tube was blocked (last day of therapy) and in 1 there was bleeding through

(4) Gastroenterology 35 583 591 December 1958

the tube though the tube probably was not the cause of the bleeding After therapy was completed, the tube was simply removed No fistulas or other complications resulted In a number of patients, the tube was thought to provide a route of antibiotic administration that meant the difference between the patient's survival and death

No complications occurred in 22 of 45 patients who received all three forms of therapy Nausea, diarrhea, vomiting, distention and/or ileus were the only complications in 12 Fungous infections in 2 infants led to use of an antifungous agent as part of routine colon preparation for all infants There were no fistulas, anastomotic difficulties or peritonitis in this series Four wound infections occurred one associated with evisceration The only patient who died was a man, aged 85, who had resection of the ascending colon and sigmoid for adenocarcinoma of the cecum, which had invaded the sigmoid Of the patients who did not receive all three forms of antibiotic therapy, 11 died The deaths were associated with colon procedures Two others died who had upper gastrointestinal carcinomas and had received preoperative antibiotics

Experimental Development of Pseudomembranous Enterocolitis was studied by Toh-Leong Tan, Christopher T Drake Myron T Jacobson and John Van Prohaska[5] (Univ of Chicago) Staphylococcus (var aureus), isolated in pure culture from known cases of pseudomembranous enterocolitis or from cases of food poisoning, reproduced the disease in chinchillas, with demonstrable gross and microscopic changes compatible with enterocolitis

The significant gross findings at autopsy were marked distention of the stomach duodenum and entire small bowel The cecum was distended to about 4 times normal size The colon showed no remarkable gross changes except in the region of the ascending segment where it was distended and contained diarrheal stools Segments of small intestine showed marked hemorrhagic areas The wall of the stomach and the small bowel appeared remarkably thin

The principal microscopic changes observed were edema of the gastrointestinal tract, leukocytic infiltration of the mucosa submucosa and muscularis superficial ulcerations passive congestion and completely sloughed mucosa in

(5) Surg Gynec & Obst 108 415 420 April 1959

many segments In particular, the stomach showed leukocytic infiltration, thinning of the mucosa and loss of normal villous structures The duodenum showed marked loss of mucosa, with ulcerations, heavy leukocytic infiltrations and fibrinomucous exudate or pseudomembrane in the lumen (Fig 130) In the small bowel the process was exaggerated to the extent of complete loss of the mucosa The colon showed minimal microscopic changes, but even here alterations compatible with inflammatory colitis were observable The high-power microscopic view of the duodenum empha-



Fig 130 —Loss of mucosa ulcerations heavy leukocytic infiltration thinning of intestinal wall and fibrinomucous pseudomembrane in duodenum under low power (Courtesy of Tan T L *et al* Surg Gynec & Obst 108 415 420 April 1959)

sized the total derangement of the bowel wall It demonstrated the marked leukocytic infiltration of the muscularis and the loss of normal mucosa

Cultures of the intestinal content were taken at autopsy In all but the first of these animals, pure cultures of staphylococcus which generated enterotoxin were reisolated The etiologic agent of pseudomembranous enterocolitis is enterotoxin producing staphylococcus

► [There is now adequate evidence to demonstrate that Staphylococcus aureus may produce a pseudomembranous enterocolitis It would appear, however, that there are other causes which have not yet been delineated as suggested by the following abstract Enthusiasm for incrimination of the staphylococcus should not stifle investigation of other etiologic factors —Ed]

Pseudomembranous Enterocolitis: Are Antibiotics Wholly Responsible? Robert M Hardaway III and Donald G McKay[6] demonstrated previously that it is possible to

(6) A M A Arch Surg 78 446-457 March 1959

reproduce consistently the pathologic changes and many of the clinical manifestations of pseudomembranous enterocolitis in dogs (Fig. 131) in the absence of antibiotics or bacterial infection. This was done by intra-aortic injection of incompatible blood.

The syndrome of pseudomembranous enterocolitis is the result of two separate phenomena, which may or may not overlap It may be classified as follows. (1) A "circulatory

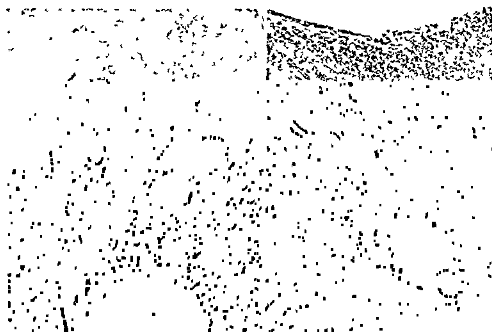


Fig 131 (left) —Pseudomembrane is fully developed in this region of dog jejunum and is composed of strands of fibrin, mucu [illegible] epithelial cells. Tips of villi are necrotic and hemorrhagic From [illegible] ogy, Water Reed Army Hospital, hematoxylin [illegible]
Fig 132 (right) —Ileum, showing nec [illegible] mor emboli and one large fibrin thrombus in [illegible] re- duced from ×100
(Courtesy of Hardaway R M III and McKay, D G A M A Arch Surg 78 446 457 March, 1959)

collapse" type, caused by intravascular coagulation in the *capillaries of the submucosa of the bowel*, is characterized by sudden onset of severe refractory shock, usually postoperative Antibiotics may or may not have been given Diarrhea may or may not be present Mortality is high—*100% if* the disease is not recognized and treated vigorously. Heroic treatment for shock, with plasma, protein and fluid therapy, is indicated (2) A "diarrhea" type is caused by a disturbance in the bacterial flora of the bowel, with predominant growth of staphylococci and development of staphylococcic enteritis and diarrhea The disturbance is often associated

with antibiotic therapy It may or may not have been preceded by surgery Staphylococci are always cultured from the stool Shock does not occur suddenly and dramatically but develops over hours or days as a result of fluid loss into the gastrointestinal tract Mortality in adequately treated patients is low or moderate Treatment consists of cessation of antibiotic therapy, administraton of a specific antistaphylococcic antibiotic and fluid replacement (3) A combined type is initiated by a simple staphylococcic enteritis but develops into the severe type when there is an episode of intravascular clotting precipitated by trauma, injection of a thromboplastic agent, absorption of tissue juices or carcinoma embolism (Fig 132), with intravascular clotting in the mucosal capillaries, or there may be staphylococcic invasion of bowel mucosa previously damaged by intracapillary thrombi This combination of bacterial enteritis and capillary thrombi may actually be the commonest etiology

Fecal Enema as Adjunct in Treatment of Pseudomembranous Enterocolitis is described by B Eiseman, W Silen, G S Bascom and A J Kauvar[*] (Denver) An attempt was made to re establish the normal intestinal bacterial flora by this method because mortality from pseudomembranous enterocolitis is distressingly high despite use of modern supportive measures and antibiotics effective against Micrococcus pyogenes Staphylococcic overgrowth occurs when other organisms disappear, hence reintroduction of bacteria, viruses and bacteriophage normally found in the colon might re establish the balance of nature, with subsidence of staphylococcic predominance and the distressing symptoms caused thereby

Three of the 4 patients with pseudomembranous enterocolitis almost died before fecal enemas were used In all, hemolytic coagulase positive Staphylococcus aureus was found in large numbers in the stool, both by smear and culture, before fecal retention enemas and disappeared after this therapy Staphylococci often seem to play a key role in the pathogenesis of pseudomembranous enterocolitis, and their disappearance from the stool is accompanied by clinical improvement Chemotherapeutic measures remain relatively ineffective in this as well as other staphylococcic infections

(*) Surgery 44 854 859 November 1958

In view of this, it is highly desirable to try other measures

Unfortunately, there is no method for producing pseudomembranous enterocolitis in experimental animals in an attempt to develop therapeutic measures under controlled conditions If further clinical experience should substantiate the beneficial effect of fecal enemas in treatment of pseudomembranous enterocolitis, more precise bacterial, viral or bacteriophage substitution therapy might be used Since the

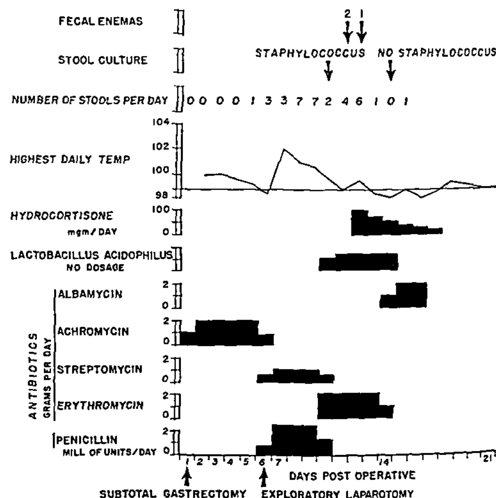


Fig 133 —Complex antibiotic regimen and response of patient after fecal enemas (Courtesy of Eiseman B *et al* Surgery 44 854 859 November 1958)

disease occasionally involves parts of the intestinal tract proximal to the colon, oral administraton of pure cultures of these organisms in enteric coated capsules might be both more esthetic and more effective

Man 65, showed signs of peritonitis 5 days after subtotal gastrectomy with a tube duodenostomy for duodenal ulcer Exploratory laparotomy revealed no leakage around the duodenostomy tube Loose

mucoid greenish bowel movements began 24 hours later, and on the 4th day, as diarrhea increased he suddenly went into profound shock Smears and cultures of stool showed M pyogenes Hydrocortisone and erythromycin produced little improvement Diarrhea stopped within 48 hours after administration of 3 fecal retention enemas (Fig 133), and normal bacterial flora appeared in the stools

► [This is an ingenious method for coping with a difficult clinical problem The previous articles indicate that this disease may now be produced in experimental animals, so this method may be more fully investigated —Ed]

Ulcerative Colitis E S R Hughes[8] (Melbourne) reviews data on 128 unselected patients aged 9 74 Most were aged 20 50, 70 were females There were 61 mild, 55 severe chronic and 12 severe acute or fulminating cases The mild group included cases of proctitis Pathologic changes were mostly in the mucosal layers, and clinical manifestations were mild Reassurance that cancer was not the cause of symptoms was sufficient treatment for many of these patients

Gross changes in the bowel and symptoms characterized by remissions and exacerbations were found in the chronic group Maximum incidence was in the 3d to 5th decades Diarrhea had been present for years, fluctuating in severity Severe pain in the right iliac fossa was common and apparently was related to ileitis These patients were in moderately good general condition, though chronic fatigue, weight loss and anemia were often present Sigmoidoscopy demonstrated edematous, red, thickened, friable mucous membrane and in the lumen a small quantity of turbid, almost purulent mucus X-rays showed a contracted large bowel with absence of haustration Localized narrowing of the lumen of the colon was sometimes present, and the terminal ileum in some cases was dilated The right half of the colon often appeared normal Nonsurgical treatment produced no more than temporary relief One stage ileostomy and proctocolectomy was performed in 27 patients, with 2 deaths In 5, an ileostomy and subtotal colectomy were performed at the first operation, and the rectum was left for a second stage, 2 patients, aged 22 and 24, have deferred the second operation Preliminary ileostomy was followed by staged resection of the colon and rectum in 2, by colectomy and ileorectal anastomosis in 2 and by proctocolectomy in 2 In a boy, 13, an ileostomy performed elsewhere was closed

(8) M J Australia 2 181 185 Aug 9 1958

without colectomy He has been well for 3 years, although he has up to 4 bowel movements daily and x-rays show a contracted large bowel One patient, 42, with a 14-year history of colitis complicated by carcinoma of the hepatic flexure had one-stage colectomy and ileorectal anastomosis

Acute fulminating ulcerative colitis is dangerous Without operation, mortality is alarmingly high, and the condition should be treated as an acute surgical emergency Ileostomy alone may prove successful, but excellent results have followed ileostomy and primary colectomy

Cancer in Patients with Chronic Ulcerative Colitis Robert C Hickey and Robert T Tidrick[9] *studied the incidence* of cancer in 326 patients with chronic ulcerative colitis observed at least once from 1935 to 1955 at the State University of Iowa Hospitals The criteria to establish diagnosis of neoplasm were not limited to histologic proof Without correction for age, duration of disease or such, 6% of the patients showed known carcinoma of the colon and rectum

In most patients, ulcerative colitis set in during the 2d or 3d decade Cancer also appeared more often in the young than in the old A view of the entire childhood and teenage group of 108 patients shows that carcinoma developed in 14 (13%) Among 49 patients with known exposure exceeding 10 years, cancer increased to 29% If patients with minimal exposure are excluded from consideration—those known to have had proctocolectomy within 5 years of onset of the disease, those dead within 5 years or those with exposure of 5 years or under—a cancer rate of about 16% is obtained Five years is, perhaps, allowable as an acceptable risk interval, 6 years was the shortest exposure period in the younger patients

Among 19 patients with adenocarcinoma of the colon or rectum, cancer was an incidental autopsy finding in 1 Four patients were living 14, 4, 2 and 2 years after operation All others died, most in less than a year, none lived 2 years

With better use of chemotherapeutic agents and antibiotics, improved nutritional measures and an understanding of electrolyte problems, more patients are attaining an extended existence with symptomatic ulcerative colitis but *concomitantly are subject to increased liability to* colon and rectal carcinoma This appears to be particularly true in

(9) Cancer 11 35 39 Jan Feb 1958

younger patients, but it must be stressed that ulcerative colitis is a disease of youth. It appears that, in the person with unrelenting ulcerative colitis with concomitant physical and economic handicaps, threat of cancer should be added as indication for proctocolectomy. In segmental involvement, partial colectomy may suffice if the patient is carefully observed. Other than as a temporizing expedient, ileostomy probably should not be considered as satisfactory, for carcinoma can develop in the defunctionalized colon.

Ulcerative Colitis: Treatment and Prognosis Studied on Basis of 161 Cases. According to John Lindenberg[1] (Copenhagen), treatment of ulcerative colitis should be primarily medical. No specific effective therapy can be recommended at present. Of the 161 study patients, 67 had pure medical treatment; 13 (19%) returned to full-time work after prolonged medical treatment. In this group, the mortality rate was 30% within an average follow-up of 12½ years.

Ulcerative colitis with acute onset often runs a more severe course than the more slowly progressive form and therefore requires closer observation. Exacerbation of the condition indicates need for more active therapy. General clinical symptoms are the best guide for determining therapy and prognosis. In assessing prognosis, the results of ordinary laboratory studies, proctoscopy and barium enema x-ray examination are of value.

Surgical treatment is indicated in: (1) regional ulcerative colitis; (2) ulcerative colitis with particularly severe general symptoms: diarrhea, persistent intestinal hemorrhage, weight loss, pain, highly febrile or septic temperature and pulse rate exceeding 120/minute; and (3) in ulcerative colitis running a more complicated course: polyposis, colonic stricture, massive colonic hemorrhage, impending perforation, acute perforation, abscesses and fistulas to the colon and rectum; also in certain cutaneous and ocular complications of rheumatoid nature, arthritis and in incipient liver damage. There is relative indication for surgical treatment in patients whose work provokes symptoms rendering them unable to work.

After ileostomy and subsequent operations, 11 (58%) of the 19 Danish patients and 40 (67%) of the 55 American patients (treated in the United States) returned to full-time

(1) Acta chir. scandinav., supp 236, 1958.

work within a short period Operative mortality was 21% among the Danish and 27% among the American group

Surgical treatment may be divided into three categories ileostomy which is the main treatment in patients with severe disease colon resection in patients with regional colitis and secondary operations such as subtotal colectomy and removal of the rectum The time for operation is determined by the progress of the pathologic processes in the colon and symptoms of particularly severe character

► [There is general agreement with the approach to therapy described by Lindenberg The problem of intractability however is not well defined In view of the high incidence of carcinoma in patients with long standing disease and the poor prognosis with treatment of this type of colonic neoplasm surgery is indicated in most patients who have recurrent disease within 10 or more years —Ed]

Surgical Management of Complicated Diverticulitis Bentley P Colcock[2] presents results in 131 patients (74 males) operated on at the Lahey Clinic during 1947 58 Ages were 30 77 25% were under 50 Symptoms of diverticulitis had been present 1 year or longer in 74 (56 5%) In 38 of 40 patients (30 5%) who had undergone one or more unsuccessful attempts at definitive surgical treatment failure was attributed to use of unsatisfactory operative procedures One patient had 8 operations before cure was obtained

In no case was severe bleeding the primary indication for surgical intervention Nearly all patients subjected to operation had severe diverticulitis and some degree of complication This was true for many of 69 patients in whom a one stage resection with primary anastomosis was carried out Partial obstruction was often present and small abscesses were found between colon and bladder or between colon and lateral abdominal wall in many Some patients with small colovesical fistulas had one stage resection and primary anastomosis No deaths occurred in this group Although a few postoperative complications developed in patients with one stage resections no patient spent more than 24 days in the hospital The average hospital stay was 15 days This figure is in striking contrast to the average hospital stay of 60 days for patients who required a three stage resection and is one small measure of the difference in morbidity for the two groups

Only 2 deaths occurred (none among those with one stage

(2) New England J Med 259 570 573 Sept 18 1958

resections), with a mortality of 1.5%. Both patients who died were over age 60 and had had symptoms of diverticulitis for many months. Perforation of the colon occurred in both. Because carcinoma was suspected, resection was performed shortly after colostomy had been established in a badly infected field, and in both cases, peritonitis and residual abscesses developed. One patient died suddenly on the 26th postoperative day of acute myocardial infarction; the other died 6 months after operation of malnutrition and sepsis. These 2 patients probably would have survived if they had been operated on earlier in the disease.

In 6 cases an adenomatous polyp was found in the resected specimen and in 1 the polyp was malignant. Both acute diverticulitis and an ulcerating carcinoma of the sigmoid were present in 2 patients. Wound infection developed in 4 patients, and in 2 the wound separated. Incisional drainage of a pelvic abscess was necessary in 1, and a temporary colocutaneous fistula developed in another. One patient had a nonfatal cerebrovascular accident.

Further reduction in morbidity associated with this disease must come from earlier operation. Patients with relatively uncomplicated diverticulitis may be subjected to definitive surgery, with a single operative procedure, a short period in the hospital and a low mortality. Resection of diseased bowel stops the recurrent attacks, perforation, obstruction and fistula formation are avoided, and the danger of allowing unsuspected carcinoma to go untreated is eliminated.

Management of Massive Hemorrhage from Diverticular Disease of Colon is reported by Charles M. Earley, Jr.[3] based on the study of 23 patients who were treated at the Medical College of Virginia Hospitals within 5½ years. Conservative management was adequate in most, but 7 had to be operated on to control blood loss. Similar surgery was done to control hemorrhage from colonic diverticular disease in 24 patients reported by others. Most of these procedures were performed as emergencies and most of the patients were over age 60. The combined mortality rate among the total 31 patients (7 of the author's) was 29%.

It is generally agreed that surgery for bleeding from diverticular disease should be undertaken after conservative

(3) Surg., Gynec. & Obst. 108:49-60, January, 1959.

work within a short period Operative mortality was 21% among the Danish and 27% among the American group

Surgical treatment may be divided into three categories ileostomy, which is the main treatment in patients with severe disease, colon resection, in patients with regional colitis, and secondary operations such as subtotal colectomy and removal of the rectum The time for operation is determined by the progress of the pathologic processes in the colon and symptoms of particularly severe character

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measures have failed Once diagnosis is fairly certain and it is apparent that transfusions are inadequate treatment, operation should not be unduly delayed Careful attempt should be made to find other possible causes of massive rectal hemorrhage, even when diverticular disease is present Of 2 patients in whom bleeding appeared to be from diverticula 1 continued to bleed after subtotal colectomy and was found to have laceration of the rectum that could not be definitely excluded as the cause of the original bleeding, the other patient continued to bleed after resection of diverticula containing bowel and it was ultimately established that stercoraceous ulceration was the cause Sigmoidoscopy and total gastrointestinal x-ray films had failed to demonstrate in both patients any pathologic condition other than diverticular disease of the colon

At operation, after it has been established that diverticula are the probable cause of bleeding, unless the actual bleeding point can be demonstrated—which is rare—all of the colon containing diverticula must be resected If the patient's condition is precarious, a Mikulicz resection is usually advisable, otherwise, primary anastomosis may be performed Several patients have been treated successfully by procedures aimed at diversion of the fecal stream and putting the diseased bowel at rest This was done in 8 reported cases with control of bleeding in critically ill patients, 7 of whom recovered (1 died of myocardial infarction on the 2d postoperative day) Four subsequently had successful colon resection, 3 had no resection, but hemorrhage did not recur In one of Earley's patients loop cecostomy was performed while the patient was bleeding massively The patient continued to bleed however, and additional surgery was necessary

Polyps of Rectum and Colon in Children are relatively rare, according to Emilio G Horrilleno, Charles Eckert and Lauren V Ackerman[4] An average of 2 or 3 cases a year were seen at St Louis Children's Hospital during 1935 55 Usually the polyps occur in the 1st decade, especially between ages 3 and 4 Boys are affected slightly more often than girls

The most important single symptom suggestive of a rectal or colonic polyp is intermittent, painless rectal bleeding

(4) Cancer 10 1210 1220 Nov Dec 1957

protruded at defecation Seven had vague rectal pain, 8 had concomitant hemorrhoids and 1 had colonic diverticulosis

The polyps varied from 5 mm to 3 cm in diameter and occurred from the level of the anal sphincter to 14 cm above this area The authors believe that this lesion may be essentially an inflammatory response in a pre existing rectal or anal fold or papilla, but the possibility of constitution determining the type of inflammatory response cannot be excluded

Follow-up on 21 patients (87 5%) showed that 17 were living and asymptomatic 2½ 20 years after treatment, 3 died 10 7, 14 7 and 2 years after removal of the lesions but showed no clinical evidence of recurrence One patient, alive 20 7 years later, has had recurrent symptoms for several years

Observations on Relationship of Benign Adenomatous Polyps of Colon to Natural History of Colonic Cancer To examine the concept that patients who are "polyp formers have greater resistance to malignant lesions of the bowel than "nonpolyp formers," Jack W Cole, Richard S O'Hara and William D Holden[6] studied two groups of patients (total 87) operated on at the University Hospitals of Cleveland during 1950 51 for adenocarcinomas of the colon and rectum Group I comprised 28 patients who had adenocarcinoma with associated polyps, the 59 in group II had adenocarcinoma without associated polyps The adenocarcinomas were typical and in both groups had identical gross and histologic characteristics Excluded from both groups were pedunculated adenomatous polyps diagnosed histologically as having a malignant focus, with or without invasion of the pedicle Only patients who underwent a 'curative resection who had a histologic diagnosis of adenomatous polyps during hospitalization, who survived the immediate postoperative course and who were properly followed were included

The polyp formers were found to have a 75% chance of being alive 6 years after resection, compared to a 46% chance for nonpolyp formers A larger group of patients must be studied to confirm the hypothesis, though these data have statistical significance

► [This is an interesting study which suggests a definite relationship between adenomatous polyps and carcinoma Certainly further exploration of this concept should be undertaken for the number of patients included in this study is quite small If these findings are borne out in a larger

(6) Surg Gynec & Obst 107 651 654 November 1958

group this observation will have considerable prognostic as well as surgical implication —Ed]

Relationship of Polyps of Colon to Colonic Cancer was investigated by John S Spratt, Jr Lauren V Ackerman and Carl A Moyer[7] (Washington Univ) Evidence that adenomatous colonic polyps are precancerous is circumstantial and consists of (1) detection of cellular populations within adenomatous polypoid masses in the colon that possess histologic characteristics of cancer and (2) seeming concordance of distributions of adenomatous polyps and of cancers in the colon, both being most numerous in the rectum and sigmoid and least numerous in the transverse colon

Histologically, cancerous cellular masses in adenomatous polyps of the colon are separable into two types In one, neoplastic cells are located in the stalk and body of the mass, in the other, they are located entirely within the polyp Although the type of carcinoma which is excluded from the stalk of the polyp may have all the histologic appearances of cancer it does not behave biologically as cancer because it does not metastasize With the stalk-infiltrative type of intrapolypoid carcinoma—a very rare lesion—metastases are known to occur However, it is not certain that these lesions were ever benign adenomatous polyps Polyps bearing invasive carcinoma in the stalks or roots may be merely polypoid carcinomas with such a propensity for differentiation that a major part of the cancer has the appearance of a benign polyp Pathologists have been unable to resolve this question

Frequency distributions of adenomatous polyps and cancers in the colon are not homogeneous (not congruent) Adenomatous polyps are more evenly distributed throughout the colon than are cancers, and the unit percentile frequencies of cancers were higher than those of polyps in the cecum, sigmoid colon and rectum and lower than those of polyps in other parts of the colon Frequency of cancer per unit length of cecum is the same as in the rectum and higher than in the sigmoid

Individual adenomatous polyps associated with colonic cancers are not randomly distributed above and below the respective cancers as they should be if colonic cancers had adenomatous polyps as their predominant loci of origin In

(7) Ann Surg 148 682-696 October 1958

the right colon, 20 of 26 polyps were located distal to the associated cancer, and in the rectum and sigmoid 68 of 92 polyps were located proximal to the respective cancers Frequencies of occurrence of adenomatous polyps in cancerous and noncancerous colons of persons over age 50 were the same Locational frequencies of carcinomas of the colon in cases of familial polyposis are not different from those of cancers in colons without polyps

Of 425 adenomatous polyps, 43 contained cellular popula-



Fig 134 —*A* and *B* adenomatous polyp with focal cancer Stalk negative Arrow in *A* indicates zone from which *B* was taken (*Courtesy of Spratt J S Jr et al* Ann Surg 148 682 696 October 1958)

tions having the microscopic appearance of cancer (Fig 134), with only 1 of the 43 having abnormal cells questionably infiltrating the stalk of the polyp Among 325 cancers of the colon, no residuum of an adenomatous polyp was seen These observations are not compatible with the theory that adenomatous polyps degenerate into infiltrating, metastasizing carcinomas of the colon Relative incidences of cancers and polyps of the colon vary between 1 260 during the 3d decade of life and 1 40 after the 7th decade

The theory of origin of adenocarcinomas of the colon within adenomatous polyps has little to support it Ob-

served frequencies of occurrence of minute infiltrating adenocarcinomas arising in nonpolypoid colonic mucous membranes are adequate to account for the annual incidence of carcinoma of the colon of 45/100,000

Even though adenomatous colonic polyps should ultimately be proved to have some malignant propensity, their eradication would not solve the colonic cancer problem Unless the required colectomies and polypectomies could be performed with mortality rates lower than half the ratios of incidences of cancers to incidences of colonic adenomatous polyps, the iatrogenic death rate would be higher than the existing cancer death rate If it is assumed that all cancers arise in polyps, operative death rates necessary for any gain are 0 27% (age 40-49), 0 3% (age 50-59), 0 5% (age 60 69), 0 6% (age 70-79) and 1 25% (age 80 and over) Since about four fifths of colonic cancers arise in nonpolyp-bearing colons, the polyp-slaying approach to the colonic cancer problem becomes absurd because mortality rates under one fifth of those listed would be necessary before there would be hope of sparing life

► [These authors make a strong case for the concept that adenomatous polyps are *not related to colonic cancer,* whereas *in the minds of most* surgeons this relationship definitely exists The only solution to the problem would be to undertake a program wherein polyps were observed proctoscopically and followed for a period of years to determine their natural course Some studies of this type have been carried out and do suggest that certain polyps undergo malignant change The exact frequency with which clinically malignant change develops is not well documented Despite the arguments presented by Spratt and his co workers the evidence circumstantial though it may be suggesting a definite relation between polyps and cancer of the colon is too strong to be ignored—Ed]

Carcinoma of Colon A W Allen and G A Donaldson[8] (Massachusetts Gen'l Hosp) report that of 217 patients who had operations for carcinoma of the colon 5 years or more ago 134 (61 8%) are alive Five operative deaths were excluded from this calculation, but all other deaths from whatever cause, many unknown, were classified as due to recurrence of cancer Only 2 died of tumor progression after 5 years, and both showed obvious evidence of an enlarged liver at 5 years Among 82 patients with palliative procedures, surgical mortality was 11% and average survival 10 months but some lived a worthwhile existence for some years All survivors live more tolerably with the source of blood loss, obstruction and tumefaction eradicated

(8) Am J Gastroenterol 30 287 299 September, 1958

Early diagnosis and operation are the most important factors in improving results in carcinoma of the colon Although an occasional patient admits no warning symptoms until a few days before examination and is found to have an incurable lesion of the large bowel, most have symptoms at a time when true diagnosis can be made, and 78% at laparotomy offer a chance for cure

Extent of resection is being scrutinized Regional lymph nodes have been included in the resection for over 2 decades and primary anastomosis after resection has completely replaced older technics There has been a trend toward routine left colectomy for all lesions on this side of the bowel In many cases, the authors removed, en bloc, contact organs and 84% of these cases were classified as curable Routine left colectomy is not desirable, but should be done when the lesion is located between two of the usual segments and when the left colon is complicated by extensive diverticulitis Resection of aortic nodes has been disappointing and this extension of the operation is seldom justified Primary ligation of veins draining the area of carcinoma in the colon is worth while and should be done whenever the liver is obviously already invaded Ligatures around the bowel well above and below the lesion furnish the most logical method of reducing chance of implantation of tumor cells in the anastomotic line Meticulous technic is of primary importance Chemotherapy and antibiotics are not a substitute for surgical technic, but if intelligently used before and after operation, they reduce morbidity

Carcinoma of Colon and Rectum in Persons under 20 Years of Age. M Tischer Hoerner[9] (Dayton, O) reviewed 188 recorded cases of carcinoma of the rectum and 72 of the colon and added 1 new case of each type Carcinomas in the right side of the colon in children do not tend to produce obstruction as do those involving the left side Mucoid adenocarcinoma constitutes about 50% of all neoplasms of the colon and rectum in children, whereas it is found in only 5% of adults with malignant disease of the colon Symptoms of malignant lesions of the colon in children are not specific Pain, the most common symptom may simulate that caused by many abdominal conditions When a child is operated on and the cause of illness is not readily apparent, the possibil-

(9) Am J Surg 96 47 53 July 1958

ity of carcinoma of the colon should be considered Accidental discovery of a mass in the right abdomen or presence of anemia may be the first indication that something is wrong with the right side of the colon Malignant tumors on the left side often cause obstruction Rectal bleeding is more common when the lesion involves the rectum

Prognosis of carcinoma of the colon in children is poor because of failure to diagnose and treat it early and because the lesions tend to be highly malignant and to metastasize rapidly Early radical resection offers the only hope of survival Removal of benign polyps of the colon may prevent malignant transformation during child- or adulthood

One of the author's patients, a boy, aged 18, with a highly malignant adenocarcinoma of the sigmoid colon, was living and apparently well, with no recurrence, 8 years after resection The other, a boy, aged 19, died of widespread extension of an inoperable rectal adenocarcinoma 7 months after exploratory laparotomy and colostomy and about 9 months after appearance of the first symptom—rectal bleeding

Study of 227 Patients with Acute Large Bowel Obstruction Due to Carcinoma of Colon is presented by Alex W Ulin, Edward W Ehrlich, William C Shoemaker and Joseph Azorsky[1] (Hahnemann Med College and Hosp) In many patients with carcinoma of the colon, acute intestinal obstruction develops at some time in the evolution of the symptom complex The obstruction may be mild and spontaneously reversible The authors' patients had to be salvaged from the emergency situation before treatment of the primary disease Over three fourths of the obstructive lesions were in the left portion of the colon, 20% stemmed from lesions of the right segment The commonest gross lesion encountered was the annular constricting lesion This was complicated in about one fifth of the patients by necrosis and ulceration, and by variants of the inflammatory process edema and abscess Obturation obstruction by barium given by mouth for diagnostic gastrointestinal series was noted in 10 patients

About three fourths of the patients complained of colicky abdominal pain Less than one-half had obstipation lasting 3 5 days, these patients vomited more than once daily Eight patients presented historic and physical features leading to

(1) Surg Gynec & Obst 108 267 272 March 1959

clinical diagnosis (including radiography) of apparently pure small bowel obstruction On hospitalization, about one fourth of the patients had distention and hyperactive peristalsis A scout film of the abdomen showed slight to marked small bowel distention in 40%

Treatment results were evaluated according to the hospitals in which they were achieved In the Philadelphia General Hospital series (104 patients), operative decompression was necessary in 74%, 39 cecostomies and 39 colostomies were performed The over-all mortality for each procedure was 32 5% Of the 104 patients with obstruction, 29% were treated by surgical decompression only, 58% by resection, including 9 primary resections for carcinoma of the right portion of the colon and 13% had no surgical therapy In the Hahnemann Hospital series (123 patients), operative decompression was necessary in 72%, 65 cecostomies and 24 colostomies were done The mortality among the colostomy patients was 25% and among the cecostomy patients, 9 2% Of the 123 patients who received definitive treatment, 17% were treated by surgical decompression only, 79% by resection and 4% had no surgical therapy

Five-Year Survival after Anterior Resection for Carcinoma of Rectum and Rectosigmoid Charles W Mayo, Martin Y Laberge and William M Hardy[2] compared two groups of anterior resections performed at the Mayo Clinic —171 in 1950 51 and 336 from 1945 through 1949 Hospital mortality in the earlier group was 4 5% and in the later, 5 8% Five year survival was 3 5% better in the later than in the earlier series Among females operated on in 1950 51, the 5-year survival was 16% better than among males, whereas in the previous series the advantage for females was only 6 2%

About two thirds of the patients were aged 50 69 Lesions were preponderantly (89 1%) in the controversial segment of the bowel, 6-14 cm from the dentate margin Almost half (47 3%) had lymph node metastases Incidence of these metastases appeared to be higher in patients with lesions situated lowest, although the number of lesions in the highest and lowest segments of the bowel was small According to Broders' classification, 91 7% were grade 1 and 2 lesions and 8 3% were grade 3 and 4

(2) Surg Gynec & Obst 106 695 698 June 1958

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For 476 traced patients (25 hospital deaths excluded and 6 patients untraced) the 5 year survival was 60 1%, compared with a 5-year survival of 51 7% for patients treated by one stage combined abdominoperineal resection and of 46% for those having two stage posterior resection Of patients without nodal metastasis, 73 1% lived 5 years and of those with metastasis, 46 3% lived 5 years Survival rate decreased as the growths approached the dentate line When metastasis was not present with lesions situated 10 14 cm from the dentate line, the 5-year survival was 75% for anterior resection, 64% for one stage combined abdominoperineal resection and 53% for two stage posterior resection When comparison was made of all patients with nodal metastasis, anterior resection was associated with a higher survival rate

Concomitant proximal colostomy produced no significant decrease in operative mortality but more than doubled the hospital stay Passage of stools is important in reestablishing the normal diameter of the bowel at the site of anastomosis

Adequate radical resection of carcinoma of the upper rectum and rectosigmoid does not require removal of the rectal sphincter in all patients Decision as to whether or not the sphincter should be sacrificed must be based on technical feasibility of removing the lesion from above and excising the intestine far enough below the lesion to accomplish complete extirpation of any distal spread When this is possible, the surgeon is justified in selecting the sphincter saving operation Anterior resection usually is difficult at best and is impossible without instruments 12 or 14 in long

► [These data are particularly significant for Mayo was one of the first surgeons to choose anterior resection as the procedure for lesions in this region In many reported series, the results are heavily weighted by the selection of patients in which the procedure was done, anterior resection often having been used primarily in patients in whom the disease was extensive and the operation was done for palliation rather than for cure

The data presented in this article as well as that which immediately follows suggests that anterior resection may be as effective as abdominoperineal resection in properly selected patients —Ed]

Study of 268 Patients with Carcinoma of Midrectum Treated by Abdominoperineal Resection with Sphincter Preservation is reported by John M Waugh and John C Turner Jr[3] (Mayo Clinic and Found) The patients were aged 22 81 (average 57 5), 169 were men Of the 268, 165

(3) Surg Gynec & Obst 107 777 783 December 1958

were operated on between 1944 and 1950 and these cases were previously reported, 103 were operated on between January, 1951, and June, 1957 Nine (3 4%) of the 268 died in the immediate postoperative period The commonest postoperative complications were urinary retention in 71 (26 5%), presacral infection in 56 (20 9%), retraction or sloughing of the perineally transplanted sigmoid in 36 (13 4%) and thrombophlebitis of the lower extremities in 13 (4 9%)

Of 155 patients followed who had been operated on 5 years or more before June, 1957, 86 (55 5%) survived 5 years Of 131 in whom the lesion was located 5 10 cm above the anal margin, 69 (52 7%) survived 5 years or more Five year survival among those without nodal metastasis was 53 (72 6%) of 73 and among those with nodal metastasis, 16 (27 6%) of 58 Satisfactory fecal control was obtained in 77 7% of the 211 patients on whom this information was available

These findings confirm data previously reported b Waugh, i e, that combined abdominoperineal resection wit preservation of the anal sphincter offers a rational methoc for treatment of carcinoma of the midportion of the rectum (5-10 cm above the dentate line) and for lesions of the upper portion of the rectum in which anterior resection is not technically possible Such procedure, if it includes ample resection of the sigmoid mesentery, perirectal tissue and the internal anal sphincter in lesions located within 1 in of the levator, constitutes a sound operation for cancer, the results of which compare favorably with those of the Miles operation

New Approach to Problem of Urinary Retention Following Abdominoperineal Resection for Carcinoma of Rectum Guy W Leadbetter, Jr and Wyland F Leadbetter[4] (Massachusetts Gen'l Hosp) reviewed the records of 62 males with abdominoperineal resections 59 were over age 50 Prostatectomy was done in 18% of the patients in 1 before and in the others after the combined operation

The commonest urologic complications after abdominoperineal resection are inability to void and residual urine There are two causes of these difficulties The first relatively uncommon is primarily neurogenic and is produced

(4) Surg Gynec & Obst 107 333 338 September 1958

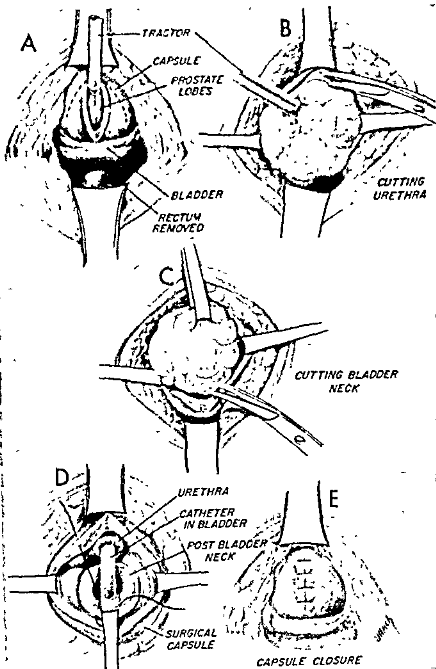


Fig. 135.—Simple prostatectomy after abdominoperineal resection: *A*, vertical incision in prostate with straight Young tractor in bladder, *B*, cutting distal urethra in prostatic capsule and at apex of prostate; *C*, cutting bladder neck and removal of adenoma; *D*, suture of posterior bladder neck to prostatic capsule; *E*, closure of capsule. (Courtesy of Leadbetter, G. W., Jr., and Leadbetter, W. F.: Surg., Gynec & Obst. 107:333-338, September, 1958.)

by wide pelvic dissection, with associated severance and trauma to bladder innervation. The second and most common vesical dysfunction results from a combination of factors—distention, trauma to local tissues or nerves and prolapse of the bladder into the pelvis.

Careful, systematic urologic evaluation before surgery can predetermine postoperative urinary difficulties. The necessity for prostatectomy was realized preoperatively in only 1 patient. The others had several episodes of acute urinary retention before prostatectomy was done. Because of the dangers that accompany a second anesthetic and operation, perineal enucleation of the prostatic adenoma should be done at the time of the abdominoperineal resection. Such a procedure adds only 15-20 minutes to the operating time.

TECHNIC.—After removal of the rectum, the posterior prostatic capsule is well exposed. A metal sound is inserted into the urethra. Thus the prostate is levered into the wound and stabilized. An inverted V incision is made through the posterior capsule into the urethra (Fig. 135, *A*). The metal sound is removed and a straight Lowsley tractor inserted through the prostatotomy into the bladder so that the prostate may be stabilized and moved as desired during adenomectomy. A plane of cleavage between the adenoma and capsule is established with scissors (*B*) and enucleation is begun. After the adenoma is freed from the capsule, the urethra inside the capsule and at the apex of the prostate is severed. With traction on the adenoma at this point the vesical neck can be seen and easily severed (*C*). After enucleation, a small wedge of tissue is removed from the posterior bladder neck to prevent subsequent contraction. A no. 22 Foley catheter with a 30 cc. bag is inserted into the bladder. The posterior bladder neck is sutured to the floor of the distal prostatic capsule (*D*). 2 sutures are usually adequate. Watertight closure of the prostatectomy is accomplished with interrupted chromic catgut sutures (*E*). The perineal wound is drained in the usual fashion. The urethral catheter may be removed on the 10th postoperative day.

Total prostatectomy and seminal vesiculectomy should be considered only when the carcinoma is over, near or attached to the prostate or seminal vesicles. In this event the prostate and seminal vesicles should be removed en bloc with the rectum.

Local Recurrences of Malignant Growth Following Complete Removal of Rectum (abdominoperineal resection) are reported in 43 cases by H. J. Groenendijk.[5] Symptoms relating to recurrence began 3-46 months (average 13½ months) after operation. Pain, sometimes at several sites, was the most common symptom, 16 patients initially showing perineal pain. Bladder symptoms were present initially in 7 and later in 26 patients. One patient returned for treatment because of general symptoms and 11 showed bleeding before pain. Whereas other initial symptoms did not recede or even

(5) Arch. chir. neerl. 10:65-70, 1958.

increased, phantom tenesmus, present in 6 patients, disappeared after some weeks or months and was followed by pain in other locations

New proliferation was usually discernible at time of first symptoms as a palpable tumor, ulceration or fistula Among 22 females, the tumor was palpable in 18 through the vagina Ulcerations in the sacral cavity, wound or fistula were present in 15 patients and palpable tumor under the perineal scar or via the colostomy in 9 and 7, respectively Among 8 with no tumor noted on physical examination, x-rays showed erosion of pelvic skeletal structure in 6

When recurrence was discovered, curative therapy was no longer possible Palliative treatment was directed principally against pain Results of irradiation varied Most patients had temporary decrease of pain for 1 week to 3 months after irradiation Results of conduction anesthesia varied, but usually an aqueous solution of procaine, Xylocaine® or Pontocaine® helped for a few hours only A viscous solution of these anesthetics diminished the pain for 2 days at most Injections with alcohol sometimes helped for as long as 7 days Surgery was performed in some patients, i e , excision of a tumor-infiltrated scar or of the os coccyx or part of the sacrum Chordotomy or lobotomy was sometimes done Usually, several therapeutic measures were combined Rather good results were obtained with a combination of chlorpromazine and alcohol injection

► [The occurrence of pain in a perineal wound following abdominoperineal resection is almost pathognomonic of recurrence. To be sure other causes of pain may be observed occasionally, but they are so rare that carcinoma must be assumed until proved otherwise and an extensive search made Not infrequently some palliation may be obtained in such patients with irradiation therapy, as indicated by Groenendijk —Ed]

Basal Cell Carcinoma of Anus · Report of Three Cases by Patrick H Hanley, Merrill O Hines and John E Ray[6] (New Orleans) brings to 50 the number of recorded cases of this rare lesion Basal cell carcinoma may start as a small papule or over many years may form a solid tumor, cyst or rodent ulcer These lesions spread peripherally under the skin, infiltrating it and the subcutaneous tissue They grow insidiously, and if not treated, continue the relentless rodent erosive destruction, with mutilation of the involved area

(6) South M J 51 1042 1047 August 1958

Basal cell carcinoma of the anus is encountered primarily in the 6th and 7th decades Age range in collected cases was 42 82 years (average 62) It is found twice as often in men as in women True basal cell carcinoma is located near the anal verge Most of these neoplasms are 1-2 cm in diameter The advanced lesion may be a destructive ulcerative or polypoid tumor involving part or all the circumference of the anal canal, with infiltration into the anal sphincter and rectovaginal septum

During early stages, basal cell carcinoma produces no symptoms In late stages, depending on location and extent, vague anorectal complaints, such as itching rectal bleeding hemorrhoids, ulcers, irritation, fistulous swelling and anal mass are noted The tumor usually causes no pain and is usually discovered incidentally during routine pathologic examination of tissue removed surgically from a clinically benign anorectal lesion or during routine physical examination, as in the authors' 3 patients Duration of symptoms varied in reported cases from 6 months to 30 years with an average of 4 years

Diagnosis is not possible without biopsy Most basal cell carcinomas are small, with obvious clinical limitation of infiltration, and present no problem in management The should be completely excised, including a wide margin (1 5 2 cm) not only at the periphery but deep beneath the tumor If total excision is accomplished, irradiation is not necessary In advanced lesions requiring radical surgical excision abdominoperineal resection (Miles) is recommended This permits wide resection of tissue without increasing morbidity or mortality In an occasional selected case e g a circumferential lesion about the anal canal with superficial infiltration into the anal sphincter irradiation may be successful

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HERNIA

Inguinal Hernia in Female Infants and Children I Richard Goldstein and Willis J Potts[7] (Children s Mem l Hosp, Chicago) review data on 173 female infants and children in

(7) Ann Surg 148 819 8 November 1958

whom 211 hernias were repaired, 44 (21%) were of the sliding type, involving various parts of the genital tract Hernia was found during the first 3 months of life in 43% Birth had been premature in 27 (15 6%) Hernias were right sided in 102 (59%), left sided in 34 (20%) and bilateral in 37 (21%) In a patient with unilateral hernia careful palpation of the opposite side is carried out 11 patients who had unilateral herniorrhaphy later returned with hernia on the other side A hernial sac on the presumably normal side cannot always be identified, nor can bilateral herniorrhaphy be advised solely because hernias are more common on the right History or presence of incarceration was noted in 31 (15%) all but 1 were on the right side Two had irreducible bowel incarcerations An ovary was often incarcerated, but only 2 patients showed signs of impaired blood supply A tender, firm movable lima bean sized mass in the inguinal region is most likely an incarcerated ovary It may be mistaken for a hydrocele of the canal of Nuck for an enlarged lymph node or for a small incarcerated intestinal segment

The method of repair for simple inguinal hernias in female infants and children is essentially the same as that for males —high ligation of the sac If the round ligament intimately adheres to the hernial sac it is included in the suture ligation of the neck of the sac The method of treatment for sliding hernias is described

TECHNIC —Under open drop ether anesthesia transverse skin incision is made in the suprapubic crease (Fig 136 *A*) Subcutaneous fat and superficial fascia are divided in the same direction Fascia of the external oblique muscle is divided in the direction of its fibers from the lower edge of the indirect oblique muscle through the external ring (*B*) The hernial sac is grasped and freed from fibers of the cremasteric muscle and connective tissue (*C*) Near the posteromedial surface of the sac care is exercised to avoid damage to the ovarian or uterine vessels The sac is opened and if the tube and/or ovary form part of the sac—typical of sliding hernia—this procedure is performed (*D*) A flap is fashioned from the side of the sac to which the adnexa and their vessels adhere by incision on each side of the vessels and parallel with them (*E*) This flap with its attached ovary or tube and vessels is folded through the neck of the sac into the peritoneal cavity (*F*) The purse string suture of 3 0 silk is so placed in the remaining portion of sac that when taut it completely closes the sac without encroaching on vessels to the ovary or tube (*G*) The redundant portion of sac is excised and the stump allowed to retract beneath the internal oblique muscle (*H*) The edges of the external oblique aponeurosis and subcutaneous tissues are approximated with

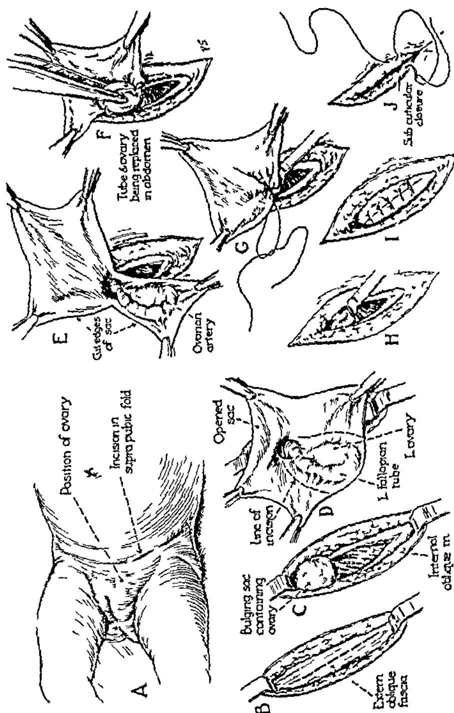


Fig 13? (Courtesy of Goldstein I R and Potts W J Ann Surg 148 819 822 November 1958)

interrupted sutures of 4 0 silk (*I*) If the patient is under age 18 24 months—not toilet trained—the skin is closed with interrupted subcuticular sutures of 6 0 white silk (*J*) In older children continuous suture of black silk or nylon is used to close the skin The wound is covered with a small piece of gauze that is fixed with waterproof adhesive tape

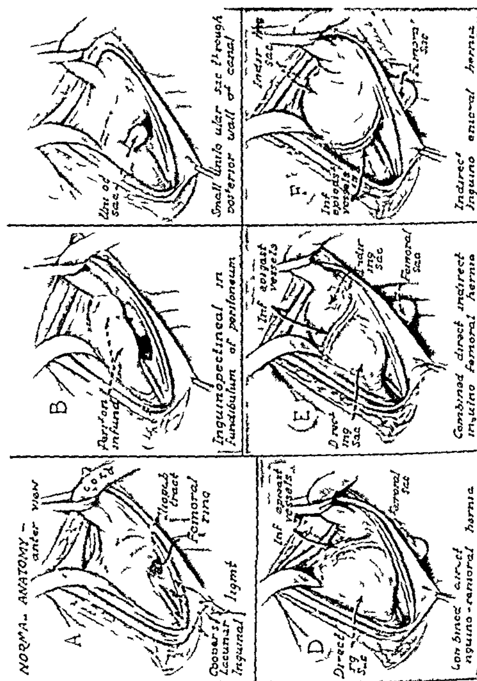


Fig 137 —Types of femoral and inguinofemoral hernias (Courtesy of B   n C C Surgery 44 877 885 November 1958)

area corresponds to the femoral arch Any narrowing of the insertion of the posterior boundary of the inguinal canal has the effect of widening the transitional area The more attenuated and wider this zone the greater the potential vulnerability to herniation

Figure 137 A shows normal anatomy Although the sac of

the femoral hernia is acquired, it must arise from the peritoneal infundibulum of the inguinopectineal region (*B*). When there is functional weakness of the posterior wall of the inguinal canal, the overlying peritoneum assumes the morphologic contour of the domelike wall which constitutes the basic weakness of a direct hernia (*D*). When this relation occurs, a portion of the redundant direct sac with its attenuated coverings derived from the floor of the inguinal canal may be forced through the femoral ring, explaining the dynamics of a direct inguinofemoral hernia. However, there is equally valid explanation for a unilocular femoral hernia (*C*). If the posterior wall of the inguinal canal remains taut except for development of a small rent through which the peritoneal sac evaginates, there is no coexisting direct hernia, and the sac remains solitary. Similarly, it is possible for a femoral hernia to spring from the indirect sac (*F*), but to do this the neck of the sac must displace the inferior epigastric vessels and floor of the inguinal canal medially beyond the level of the femoral ring. When this rare structural distortion occurs the fascia transversalis obviously would not be interposed as a barrier between the indirect sac and the femoral ring.

For coexistent direct inguinal and femoral hernia (Fig. 137, *E*), Burton proposes a combined Cooper's and inguinal ligament repair as standard treatment. There are anatomically and clinically valid reasons for approaching every hernia of the inguinofemoral region superiorly, by exposing first the peritoneum at the internal inguinal ring and determining by digital exploration the number and extent of saccular variants.

When a femoral hernia is present, it is reduced so that the sac lies in the inguinal region. By dissection, the sac can be brought into the region of the inguinal ring and excised as an indirect sac. This technic of retrogressive mobilization of components of the sac has led to greater appreciation of saccular loculation and allows the surgeon to palpate the entire posterior wall in evaluating its integrity to determine the type of repair.

Of 165 femoral hernias, 82 (49.7%) were unilocular, 50 (30%) showed coexisting direct inguinal hernias and 33 (20%) showed combined indirect and direct inguinal components which communicated with the femoral loculation.

In reality, 83 (50%) of the femoral hernias were combined inguinofemoral hernias

Inguinal and Femoral Hernioplasty Evaluation of Basic Concept is presented by C B McVay (Univ of South Dakota) and John D Chapp[1] (Univ of Kansas) This basic concept is that in repair of groin hernias that compromise

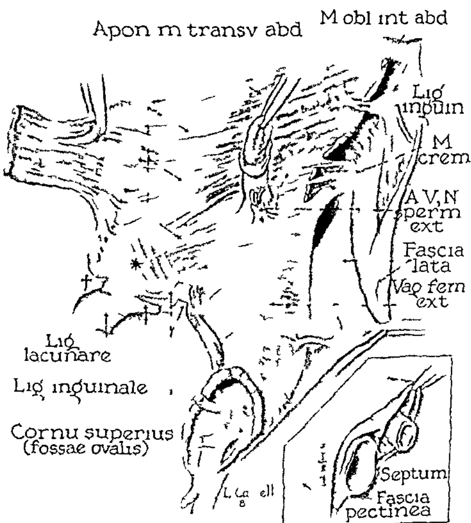


Fig 138 —Anatomy of transversus abdominis muscle and aponeurosis in inguinal region Anterior femoral sheath is continuation of transversalis fascia excised Inguinal ligament is not part of all important posterior inguinal wall (transversus abdominis aponeurosis) (Courtesy of McVay C B and Clapp J D Ann Surg 148 499 510 October 1948)

the posterior inguinal wall (large indirect direct and femoral hernias) Cooper s ligament (ligamentum pubicus superius) should be used and not the inguinal (Poupart s) ligament The transversalis fascia is the innermost muscle

(1) Ann Surg 148 499 510 October 1958

fascia of the transverse abdominal muscle. Where the layer is muscular, as at the abdominal inguinal ring, it is easily separated as a definite layer, but where the layer is aponeurotic, the fascia becomes fused with the aponeurotic fibers, forming a single layer. In the inguinal region and behind the spermatic cord this layer is designated as the posterior inguinal wall (Fig. 138). The variable strength and distribution of this layer condition the development of direct inguinal and femoral hernias. When the aponeurotic fibers are sparse, direct inguinal hernia is likely to develop because

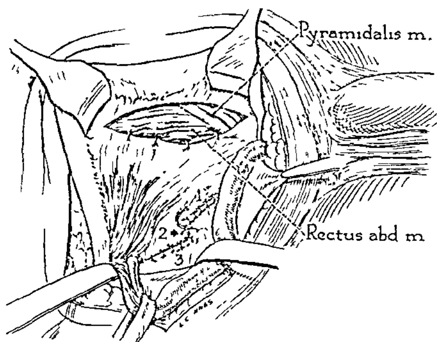


Fig 139—Reconstruction of posterior inguinal wall 1, rectus sheath sutured to Cooper's ligament; 2, transition suture, 3 transversalis fascia sutured to anterior femoral sheath (Courtesy of McVay, C B, and Chapp, J D Ann Surg 148 499 510, October, 1958)

the posterior inguinal wall is weak. With a narrow insertion of the posterior inguinal wall into Cooper's ligament a femoral hernia is likely to develop because this leaves a broadened femoral ring The posterior inguinal wall inserts into Cooper's ligament and has only a contiguous relationship to the inguinal ligament.

For small to medium-sized indirect inguinal hernias, the hernial sac is excised and the abdominal inguinal ring tightened to normal by suturing the transversalis fascia to the anterior layer of the femoral sheath, medial to the cord. For large indirect inguinal, direct inguinal and femoral hernias,

a new posterior inguinal wall is constructed (Fig 139) This consists of excising all attenuated aponeuroticofascial structures, the relaxing incision and a "slide" of the rectus sheath into the position of a new posterior inguinal wall which is sutured to Cooper's ligament as far laterally as the femoral vein and after the transition suture, the transverse fascia is sutured to the anterior layer of the femoral sheath far enough laterally to make a snug abdominal inguinal ring In both repairs the spermatic cord is replaced in its normal position and the external oblique aponeurosis closed to make a snug subcutaneous inguinal ring in the normal position

In a series of 580 hernioplasties, the inguinal ligament was not used In a 1-11 year follow up on 91% of these patients, results in 236 reconstructions of the posterior inguinal wall for difficult hernias showed a recurrence rate of 0 85% Less dramatic results in 344 abdominal inguinal ring repairs for simple indirect inguinal hernia with recurrence rate of 3 2%, point out the importance of high ligation of the sac with closure of the abdominal inguinal ring

Inguinal and Femoral Hernioplasty Results Following Bassini and McVay Repairs were compared in 244 cases of the former and 364 of the latter operation by Jørgen Lund and John Lindenberg[2] (Copenhagen) Distribution of various factors influencing recurrence rate was about the same in the two groups (table) All patients were treated by early mobilization, i e, ambulation the day after operation Frequency of wound complications (hematoma and infection) was the same in the two groups (5 10%) Nonabsorbable suture material was used in all patients

Within the first year after operation considerably fewer recurrences were noted after the McVay (3%) than after the Bassini procedure (13%) The ultimate result of the McVay method will probably be a recurrence rate of about 5% whereas for the Bassini operation the corresponding figure is 26%

Surgeons performing the McVay operation were divided into three classes according to operative experience recurrence rate in patients in these three groups was about the same All surgeons could reduce recurrences from 12 13% to 3-4% during the 1st year by the McVay operation

The McVay procedure involves working close to the fem

(2) Acta chir [illegible] 11[illegible] 36[illegible]3 3 19[illegible]8

oral vein on the lateral side In this series, only 1 patient showed injury to the femoral vein with untoward effects A suture caught part of the venous wall and 8 days after operation, venous thrombosis of the homolateral limb developed The weak spot of the McVay operation is at the abdominal ring. Three of 7 recurrences localized at the internal orifice were due to erroneous placing of sutures in Poupart's ligament, the other 4 were due to failure to continue the repair far enough laterally, anterior to the femoral vessels

The McVay operation presupposes particular care in suturing the abdominal orifice If one desires, the ring may be

DISTRIBUTION OF VARIOUS FACTORS INFLUENCING RECURRENCE RATE*

	Indirect inguinal hernia		Direct inguinal hernia	
	Bassini	McVay	Bassini	McVay
Women	14 per cent	11 per cent	7 per cent	2 per cent
Age				
Under 20 years	5 —	5 —	0 —	0 —
20—30 »	12 —	10 —	7 —	4 —
30—40 »	23 —	20 —	17 —	10 —
40—50 »	23 —	31 —	19 —	33 —
Over 50 »	36 —	34 —	57 —	53 —
Duration of hernia				
Less than 1 year	54 —	66 —	49 —	69 —
1—2 years	8 —	8 —	7 —	9 —
More than 2 years	38 —	26 —	44 —	22 —
Size of hernia				
Small	31 —	29 —	34 —	37 —
Medium sized	45 —	50 —	56 —	46 —
Large	24 —	21 —	10 —	17 —
Bilateral hernia	15 —	24 —	34 —	33 —
Strangulated hernia	8 —	2 —	3 —	4 —
Recurrent hernia	9 —	8 —	16 —	11 —

*There is marked clinical uniformity between the 2 operative groups, both in indirect and direct hernia

closed separately, before sutures are applied to Cooper's ligament If mistakes in this area are avoided, both experienced and inexperienced surgeons can obtain a low recurrence rate in all types of hernia of the inguinofemoral region

Femoral hernia (61 cases) appears to show the same recurrence rate after Lotheissen's and McVay's operations (about 5%)

Marlex Mesh, New Plastic Mesh for Replacing Tissue Defects—*I Experimental studies*—Marlex mesh is prepared from a monofilament 8 mils in diameter The thread count is

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42×40 in (tantalum gauze is 50×50/in) A simple taffeta weave is used, which gives the mesh exceptional strength and prevents raveling The mesh can be cut to the desired pattern after autoclaving By searing the cut edges with a cautery, a seal is obtained that permits sutures to be placed within ⅛ in of the edge without pulling through

Francis C Usher and John P Gannon[3] (Baylor Univ) report experiments on 31 dogs in which Marlex mesh was used to replace large defects in the abdominal wall chest wall and diaphragm The dogs were killed at intervals up to 6 months Inspection of grafts at autopsy and histologic examination showed the mesh to be well infiltrated with pliable fibrous tissue Comparisons with Teflon fabric implanted as a control showed more uniform infiltration of the Marlex mesh and better bondage to surrounding tissues

Examination of the mesh after 6 months' implantation showed no fragmentation and no decrease in tensile strength Infection studies demonstrated that granulation tissue would grow through the mesh in the presence of purulent infection without slough of the graft or sinus formation

II Clinical studies—Usher John G Fries John L Ochsner and L L D Tuttle Jr[4] used Marlex mesh in 78 patients for repair of hernias or other tissue defects

For incisional hernias the technic is simple closure of the hernial ring (after excision of the hernial sac) with interrupted braided wire sutures and suture of the mesh under moderate tension over this repair (Fig 140) In 7 patients the defect was too large to be closed by approximation of the edges of the hernial ring and imbrication of the hernial sac was impossible In these Marlex mesh was stretched across the open defect, suturing it to the inner aspect (peritoneal) of the abdominal wall as an "inner boot" Mattress sutures through the entire muscular portion of the wall were used to suture the graft in place Catheter suction drainage with the Stedman pump was used in all incisional hernias Serum accumulation after removal of drains in 10 patients was removed by repeated aspiration There were two wound infections among the 48 incisional hernias repaired in this manner, both healed by secondary intention

Marlex mesh was used in 23 large direct or direct indirect

(3) A M A Arch Surg 78 131 137 January 1959
(4) Ibid pp 138 145

ect. Wound healing was by primary intention in all, and the abdominal cases, a firm wall resulted.

ılthough these patients cannot yet be evaluated from the ndpoint of recurrence, the firm repair resulting from use this prosthesis has been impressive.

THE EXTREMITIES

:onservative Method of Repairing Surface Defects of **wer Extremities Where Bone is Exposed** and use of ped- grafts is not feasible, because of general or local condi- ıs, is described by S. Baron Hardy[5] (Baylor Univ.).

IETHOD—The wound around the exposed bone area is kept clean relatively free from infection, and granulating areas, if present



Fig 141 (top)—Operative view of leg after sequestrectomy
Fig 142 (bottom)—X ray findings at time of operation showing complete de cation of sequestrum of tibia
(Courtesy of Hardy S B Am Surgeon 24 944 951, December, 1958)

grafted up to the exposed bone, using split-thickness skin grafts ıs reduces the size of the defect and makes control of infection out the bone easier Usually this is done as a preliminary procedure ause there are usually varying degrees of soft-tissue damage sur- nding the exposed bone Bone sequestrum forms and its progress

(5) Am Surgeon 24 944 951 December 1958



Fig 143 —Appearance of leg before final split thickness skin grafting granulation tissue has covered bone (Courtesy of Hardy S B Am Surgeon 24 944 951 December 1958)



Fig 144 —At follow up about 2 years later (Courtesy of Hardy S B Am Surgeon 24 944 951 December 1958)

is followed with x-rays. After the sequestrum is well formed and demarcated, it can be removed surgically (Figs 141 and 142). No doubt, the sequestrum would separate spontaneously in time, but this would be a slow process. When only a small area of bone is involved, surgical removal of this area back to good healthy bone hastens formation of granulation tissue so that grafting can be done sooner. Before attempting surgical removal, it is important to let the sequestrum demarcate itself well. In a man, aged 43 (Fig 141), even though sequestrum appeared to involve nearly half the circumference of the tibial shaft, no opening was made in the medullary cavity by removal of the sequestrum, which proved to involve only the outer portion of the cortex. After removal of sequestrum the area is allowed to granulate so that a good surface of granulation tissue is present over the bone on which a split-thickness skin graft is placed (Fig 143). "Take" of the graft is usually complete because of this good bed. Remaining bone structure proved adequate for support so that no subsequent bone grafting was necessary.

At best, the conservative method is a compromise procedure but, when indicated, serves to supply adequate covering (Fig 144), which holds up well with suitable care. The conservative method is not advocated as a substitute when repair by pedicle graft can be carried out. This type of treatment is prolonged, but patients are discharged while sequestrum is forming and can carry on some activity. One patient was able to perform his regular work.

Management of Hand Injuries is described by William B Stromberg, Jr., Michael L Mason and John L Bell[6] (Northwestern Univ.). Preparation of the wounded extremity for surgery is carried out under operating room conditions. Patients with severe injuries receive a general anesthetic before any cleansing is done. The operation is carried out with use of a blood pressure cuff about the upper arm inflated to 270-280 mm Hg; uninterrupted pressure is maintained during wound excision and identification of all injured structures. Needless sacrifice of hand skin, especially on the volar aspect of the palm, must be avoided. All viable skin should be saved, even irregular tags that may often be dovetailed into each other for closure. Skin flaps with distal pedicles, flaps torn loose as a cuff and those in so called degloving injuries cannot be simply laid back and sutured. The flap that remains perfectly white, even with release of pressure in the cuff, will not survive and must be excised.

If muscle fails to bleed or contract when stimulated it should be excised. Tendons are not sacrificed even if immedi-

(6) S. Clin. North America 38:1501-1515, December, 1958.

ate repair is not indicated, unless they are badly damaged or go to digits already amputated Tendons must be covered with subcutaneous tissue and skin if they are to survive Nerve tissue should never be excised unless there are loose ends protruding from amputation stumps In a badly crushed wound nerves are left alone and placed in anatomic position in a bed of fat or muscle Divided nerve ends are brought into approximation if at all feasible at the initial operation Bone fragments that have kept their soft-tissue attachments will survive and should not be removed The only two absolute indications for amputation of a part are loss of blood supply and impossibility of restoration of function Even a badly crippled finger is of more use than no finger

Experience suggests caution in attempting primary repair of flexor tendons between the proximal finger flexion crease and the distal palmar flexion crease Four hours is a safe time limit for primary flexor tendon repair in the palm and 2 hours when the injury is in the digit When primary repair is followed by infection, function is destroyed and secondary repair and reconstruction are made many times more difficult Sites of deep-tissue reconstruction and repair must be covered with as nearly normal tissue as possible Tendons left exposed in a wound are sure to become necrotic, and tendon repair under these circumstances is futile

Gentleness in handling of tissues is a prime requisite in hand surgery Rough retraction, rubbing the tendons with gauze and grasping large amounts of tissue with hemostats add to delay in healing and to scar formation Careful repair of deep structures demands adequate exposure Tendons, especially flexor tendons, tend to retract from the accidental wound These must be recovered by accessory incisions rather than by groping about with a hemostat or forceful retraction of the wound edges

Extensor tendons can be repaired more readily than flexor tendons Flexor tendons divided distal to the midportion of the middle phalanx may be primarily sutured if all other conditions are met The suture line should not be too close to the pulley over the middle phalanx lest it become adherent Results of tendon suture between the middle flexion crease of the finger and the distal palmar crease are not always satisfactory (secondary repair is not always successful either) In a clean cut wound that has been covered with dressing and

examined within 2 hours after injury, primary repair may be permissible, particularly in the young patient Primary tendon grafting in this region is not recommended Division of the flexor tendons in the palm can be repaired with assurance Injury here is often associated with digital nerve damage and this should always be looked for Division of the flexor pollicis longus is usually amenable to primary repair though some surgeons advise against exploration in the thenar area *For tendon suture, the sutures must be the finest, compatible with required holding power*

Primary nerve suture, when feasible, is preferred to delayed suture Suturing is done with the finest material, with care used to pass the suture through only the perineurium and not the substance of the nerve The authors use interrupted sutures of 6 0 ophthalmic silk with swaged *on needle*

Fractures of phalanges and metacarpals can often be reduced by manual manipulation and the part molded over a splint in the position of function This position can be maintained by compression dressing, occasionally traction may be required Severe crushing injuries of the hand with associated fracture require over-all compression dressing with the hand *molded* over a *universal splint*

After wound excision, deep repair and wound closure, the operation is completed by applying a compression dressing and immobilizing the splint

Third-Degree Burns of Dorsum of Hand John A Moncrief[7] (Brooke Army Med Center) reports results of early excision and grafting in 27 hands (17 patients) involved in full-thickness burns of the dorsum Except in 2 patients, all digits sustained full thickness burns, and damaged skin was excised The dorsum of the hand was excised in all 27 In 15 patients the forearm was also excised circumferentially usually up to and occasionally including the elbow Excision was accomplished at varying periods from the day of injury to the 7th day afterward Experience proved that 48 72 hours was the optimum interval Grafting was done 2 13 days after excision but skin coverage in most was attained the 2d or 3d day The area of grafting was determined by the area of excision For restoration of function it was of prime importance that excision be carried to the midlateral portion of the digits Deep darts were made over interphalangeal joint

(7) Am J Surg [illegible] 3 544 October 1958

areas Excision of both interdigital web spaces and the thenar web was carried well onto the palm Areas of thenar and hypothenar space eminences requiring excision were removed so that their margins were in a broken, curved line When dressings are not changed the 2d or 3d day after grafting, considerable graft loss may result from infection in the area of 2d-degree burn on palms and digits

Physical therapy is instituted as soon as graft takes are stable enough to allow active motion Often treatment is started in a whirlpool tank immediately after the second dressing change This increases range of motion rapidly and keeps the hand much cleaner than any other method The



Fig 145 —Hands 154 days after burn and 153 days after excision Grafted 3 days after burn Middle slips of extensor mechanism on 2d 3d and 4th digits of right hand were destroyed by fire These joints were pinned resulting in fusion in position shown Excellent functional result (Note that 3d degree burns of forearms were also excised Venous network remains prominent) (Courtesy of Moncrief J A Am J Surg 96 535 544, October 1958)

primary object is to increase flexion of the metacarpophalangeal joints and to obtain maximum abduction of the thumb Adequate range of motion of the hand and its digits was accomplished within 3-9 weeks after injury Full range of motion, including fully coordinated and delicate movements, was accomplished in 12 of 21 hands In those not gaining full range of motion, function attained was adequate for writing, eating and using the hand for all but the most intricate movements One patient had to have the interphalangeal

joints fused because of the depth of the burn (Fig 145) Even so, he had sufficient function to enable him to grasp objects of moderate size without difficulty and to write, dress and care for himself

The time necessary for return of sensation in grafted areas varied Digits and proximal portions of the forearm or hand were the first to regain feeling Light touch could be perceived on the 14th-18th day after grafting, and sharp or dull sensations and temperature changes were noted after 30 days

Management of Burned Hand is discussed by D C Robertson[8] (Univ of Toronto) on the basis of a 10 year experience with over 250 patients with burns, of whom about 50 had burns of the dorsum of the hand Open treatment has limited application in the hand Any extensive burn of the hand is treated by the closed method This method consists in multiple debridement and not in excision Grafts can be placed on tissue which is just beginning to granulate and which will maintain the characteristics of subcutaneous tissue Full takes have been accomplished in all cases

TECHNIC —The hand is immobilized in a position of function for 11 days Then the dressing is changed under light anesthesia in the operating room All necrotic tissue is removed If there is considerable discharge re dressing is done with dry pads only, if burned areas are dry a layer of petroleum jelly is applied, and dressing pads are moistened in saline before they are reapplied Four such debridements and changes of dressing are done every 48 hours before grafting is performed usually on the 17th or 18th day

A skin graft about 0 01 in thick is applied to the hand without sutures and the hand is dressed in a universal splint Five days later dressings are removed When the outer bandages are taken off and the splint is removed, the whole hand with the dressing pads in place is immersed in warm water or saline Dressings float off easily and the patient is encouraged to begin movement of the fingers at first very gently After an hour or so the hand is re-dressed and the splint is reapplied The same procedure is carried out twice the next day Time taken for range of motion to increase allows grafts to become firmly settled Periods spent out of dressing and splint are increased fairly rapidly and by the end of a week no further dressings are used Physical therapy at this stage is accomplished by the patient himself, following instructions given by the surgeon Later a more formal program may be adopted but this is often unnecessary since movement returns quickly without it

Deep burns of the hand involving a tendon and joint capsule, should also be treated conservatively In 14-18 days the

(8) J Bone & Joint Surg 40 A 625 637 June 1958

extent of damage is readily apparent, and excision of gangrenous portions of the finger with immediate repair by grafting may be undertaken if necessary.

Results have been excellent. There was no instance of contracture resulting in important restriction of flexion. In 3 patients grafts became thick and lumpy with intermittent fissures over the joints; these were treated after 6 months by complete excision of skin of the dorsum of the hand and fingers with resurfacing by a dermatome graft about 0.018 in. thick, with excellent results. On the average, patients recovered full motion of the fingers in about 3 months. Some, of course, never regained full motion, and many continued to improve after 3 months. The only complication was a Volkmann's ischemic contracture of the intrinsic muscles of the hand. This was attributed to pressure due to swelling deep within the hand and not to the dressing. This hand was treated by division of the interosseous tendons through a longitudinal incision over the proximal phalanx, which provided an excellent approach to these structures on each side.

Lymphangioplasty for Filarial Lymphedema was developed by U. Mohan Rau[9] (Govt. Gen'l Hosp., Madras, India).

TECHNIC.—Under general anesthesia a small incision is made into the subcutaneous tissue near the nipple on the side of the lymphedema. Through this, a long-eyed probe in which 2 long (40-in.) strands of nylon has been threaded is introduced. The tip of the probe is pushed subcutaneously downward as far as it will go. A second incision is made over the tip of the probe and the probe and nylon pulled out from the subcutaneous region through this incision. The tip of the probe is reintroduced through the second incision and pushed through the subcutaneous tissue downward as far as it will go. A third incision is made over the tip of this probe and the probe and nylon delivered through this incision as before. This process of burying the nylon strands through the subcutaneous tissues is repeated until the region of the ankle is reached, thus burying 2 long strands of nylon from the chest to the ankle, subcutaneously. It is not necessary to fix these strands in the subcutaneous region. Usually 6 strands of nylon, in groups of two each and about 1 in. apart, are buried, and for each pair 4 small incisions are used. For the occasional bleeding from the incisions, hemostasis is procured by manual pressure. The incisions are closed with 1 stitch for each incision and then dressed as usual, after which the patient returns to the ward.

In 3 patients with much hyperplastic filarial subcutaneous tissues and excess of skin, lymphangioplasty was combined with excision of excess tissues. In a patient in whom the foot

(9) Indian J. Surg. 20:40-52, February, 1958.

was involved, excision was done by a midline dorsal incision, *with extension to the medial and lateral borders of the foot* from the lower end of the median dorsal incision After excision of the subcutaneous tissues, the excess in the skin flaps was suitably trimmed In a patient with the leg involved similar procedures were adopted, with use of 1 longitudinal incision on the inner and another on the outer aspect of the leg

Nylon lymphangioplasty alone was performed on 11 patients After a 6 year follow up, satisfactory results were *noted in only 3 patients who had mainly lymphedema* In the other patients who also had much hyperplastic subcutaneous tissues and excessive skin mere lymphangioplasty was not satisfactory Even though there was indirect evidence that the lymph was being efficiently drained away, the excess tissues did not regress In 3 patients of this type, lymphangioplasty with excision of excess skin and hyperplastic subcutaneous tissues was done, in 2 short- and long term results were good

Almost all patients who were operated on were economically underprivileged worked and walked about barelegged and barefooted and hence could not have elastic supports for the diseased limbs Some were neglectful of hygienic care of the edematous limb If precautions had been taken, the percentage of good results might have been improved

ANESTHESIA

Edited by

STUART C. CULLEN, M.D.

DEPRESSANT DRUGS

Comparison in Man of Effects of Promethazine, Secobarbital and Meperidine Alone and in Combination on Certain Respiratory Functions and for Use in Preanesthetic Medication was made by Lawrence D Egbert, Martin L Norton, James E Eckenhoff and Robert D Dripps[1] (Univ of Pennsylvania) Promethazine is an antihistamine which has been reported to produce sedation, protect animals against anaphylactic shock, prevent pulmonary edema caused by noxious gases or epinephrine, reduce nausea and vomiting, dilate coronary vessels, have no effect on the blood pressure and stabilize the cardiovascular system

In clinical double-blind studies it was found that promethazine is a mild sedative, with an intensity of action comparable to that of secobarbital when dosage ratios of 1 2 are compared (50 mg promethazine and 100 mg secobarbital) It adds to the sedation provided by secobarbital or meperidine The sedation offered by either promethazine or secobarbital is adequate for relief of apprehension in most patients before operation, increased doses of sedatives do not seem to help greatly in reducing this complaint

Promethazine did not reduce the incidence of nausea and vomiting in the immediate postoperative period on a statistical basis Nor did the drug reduce the incidence of immediate postoperative restlessness

The respiratory actions of promethazine are difficult to assess Two observations suggested a modest stimulant effect an increased respiratory rate and minute volume were noted in volunteers receiving the drug, and the degree of reduction of respiratory rate and minute volume caused by

(1) South M J 51 1173 1177 September 1958

meperidine was no greater with addition of promethazine Promethazine probably has little significant effect on respiration in man

During the study observers were asked to guess whether the patient had received promethazine There was no correlation between guess and reality

Promethazine did not have a deleterious effect on blood pressure or pulse rate There seemed to be a slight slowing of the pulse when sedation was more pronounced

Side effects prominent among volunteers were pain at the site of the intramuscular injection, dryness of the mouth and restlessness

► [In view of the widespread application of promethazine (and similar drugs) for premedication it is surprising that there are so few controlled observations on the effectiveness of the drug This article is a refreshing objective inquiry into promethazine The reader should be careful to note that the authors make a distinction between *sedation* (*drowsiness*) and the relief of apprehension Contrary to a common concept promethazine seems not to diminish apprehension The reader should also note that contrary to popular notion the action of promethazine is not so outstanding that its presence is easily determined —Ed]

Comparison of Barbiturate Antagonists in Thiopentone Anesthesia for minor procedures was carried out by E F O'Riordan and A D Breward[2] (Munster, Germany) in 55 patients who were divided into five groups Ten controls received no analeptic, 10 were given nikethamide, 1 Gm , 5, picrotoxin 6 mg , 10 Megimide 50 mg and Daptazole 15 mg , and 20 Megimide, 100 mg Blood pressure, pulse and respiration were recorded before anesthesia, immediately after injection of thiopentone and after injection of the analeptic

Although the number of patients studied was too small for valid statistical analysis Megimide alone and combined Daptazole and Megimide provided the most effective means for reversing thiopentone anesthesia Patients in these groups regained consciousness rapidly and injection of the analeptic restored the blood pressure pulse and respirations to near preanesthetic values After consciousness had been regained, the patients were somewhat drowsy and usually went into light sleep from which they were easily awakened and most could leave the hospital within 2 hours after operation Only 1 of the 10 patients who received thiopentone alone recovered sufficiently to leave 2 hours after start of anesthesia

(2) Anesth & Analg 37 126 1 9 May June 1958

None receiving picrotoxin were fit to leave within that time and only 1 who received nikethamide

Picrotoxin was given to only 5 patients because, although drowsy, they were irritable and restless after the injection and often showed large rebound in blood pressure Even though anesthesia was lightened by the picrotoxin there was little real acceleration in recovery

Whatever the exact pharmacologic action of Megimide, its specificity for the barbiturates is pronounced In doses of 100 mg, this drug was of little value as an analeptic when the main anesthetic agent was cyclopropane (4 patients), trichloroethylene (3 patients) or ethyl ether (3 patients)

These findings are applied to barbiturate intoxication by regarding the coma as prolonged, deep anesthesia Morbidity and mortality of such anesthetization are lessened by achieving a lighter plane of coma if this is safely possible The accumulating literature and the authors' own results suggest that Megimide and Daptazole provide the safest, most efficient means for combating coma produced by barbiturates

► [The status of Megimide and Daptazole as antagonists to barbiturates is not well established The data presented in this and similar inquiries are insufficient to resolve the problem Numerous details pertinent to evaluation of the investigation reported are absent and assessment of the validity of the data is not possible—Ed]

Evaluation of New Analgesic Agent. d-Propoxyphene Hydrochloride (Darvon) in Preanesthetic and Postanesthetic Management is presented by George Valentine and Stevens J Martin[3] (St Francis Hosp, Hartford, Conn) Preoperative administration of a capsule containing 65 mg d propoxyphene hydrochloride reduced somewhat the amount of anesthetic agent required for induction and maintenance of anesthesia for major operations This dose did not produce somnolence, euphoria, amnesia, respiratory or cardiovascular depression, nausea, vomiting, urticaria or undue irritability of the central nervous system Secretions of the respiratory tract were not significantly depressed

d Propoxyphene hydrochloride given in the postoperative period produced a definite beneficial analgesic action, which was greater than that obtained by use of 32 5 mg codeine phosphate

Comparison was not attempted between the effects of d

(3) Anesth & Analg 38 50 55 Jan Feb 1959

propoxyphene hydrochloride and agents stronger than codeine phosphate in relieving postoperative pain Such a study might reveal that d-propoxyphene hydrochloride has further advantages or limitations

In many instances doses of 130 mg were given postoperatively (and not considered in this study) which increased the analgesic action without causing any adverse effects

d-Propoxyphene hydrochloride appears promising as a mild analgesic that can be used by anesthesiologists Its essential disadvantage is that it is available only for oral use

Duration of Action of Levallorphan was investigated by Mark Swerdlow [4] Four groups of patients were given an intravenous injection of levallorphan (in 1 100 ratio) 1, 1½, 2 and 3 hours, respectively, before a standard dose of pethi-

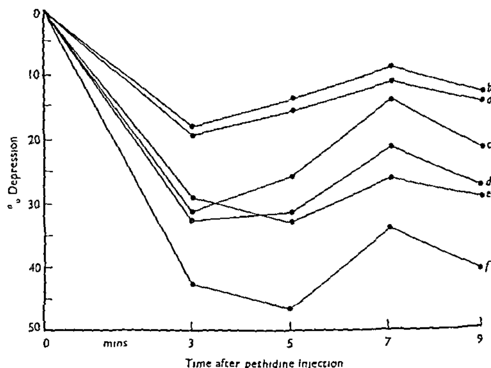


Fig 146—Minute volume changes *a* levallorphan plus pethidine *b* levallorphan 1 hour before pethidine *c* levallorphan 1½ hours before pethidine *d* levallorphan 2 hours before pethidine *e* levallorphan 3 hours before pethidine *f* pethidine alone (Courtesy of Swerdlow M Anaesthesia 14 178 183 April 1959)

dine In each group the effects of the pethidine on the respiratory rate and minute volume were measured Findings were compared with those in patients who received this dose of pethidine alone and others who received pethidine mixed with levallorphan (100 1)

(4) Anaesthesia 14 178 183 April 1959

Statistical analysis showed that when levallorphan is given not longer than 1½ hours before pethidine, the depression of respiratory rate is significantly less than that resulting from pethidine alone. At longer intervals, the respiratory rate reflects diminishing protection by levallorphan. The minute volume, however, is significantly better with levallorphan at all intervals (Fig. 146).

If the effects of levallorphan given at various times before pethidine are compared with the effects when levallorphan is given together with pethidine, at the 1-hour interval (table), protection is similar to that provided by synchronous administration of levallorphan. When pethidine is

COMPARISON OF P+L WITH LEVALLORPHAN-BEFORE-PETHIDINE GROUPS

DRUG SEQUENCE	RESPIRATION RATE "T"	RESPIRATION RATE P	MINUTE VOLUME "T"	MINUTE VOLUME P
L 1 hr before P	1 9	P> 05	0.3	P> 05
L 1½ hrs before P	3 8	P<.001	3.2	001 <P<.01
L 2 hrs before P	5 9	P<.001	5.2	P<.001
L 3 hrs before P	6.1	P<.001	6 4	P< 001

given, at 1½ hours protection has begun to diminish and 2 and 3 hours after levallorphan protection is significantly diminished.

In an earlier clinical study, the authors administered a dose of levallorphan before anesthesia with thiopental-nitrous oxide-oxygen, supplemented by intermittent doses of alpha prodine and found that in operations of up to 5 hours' duration respiratory depression rarely developed. It was then surmised that levallorphan had 2-5 hours' duration of action. However, in that study, respiratory exchange was not actually measured, presence of surgical stimulation no doubt influenced the depth of respiration and also a diminishing amount of alpha-prodine (in milligrams/minute) was administered during the last 2 3 hours. Estimate of the length of action of levallorphan was therefore not necessarily exact.

The present work affords a better idea of the duration of useful antagonism afforded by levallorphan against opiate-induced respiratory depression. Effective protection is provided for 60 90 minutes, after which progressively less protection is afforded.

Choice of Pressure-Breathing Apparatus Factors to Consider are presented by Meyer Saklad, Elihu Saklad and Charles V Cox[5] (Rhode Island Hosp, Providence) The intrapulmonary pressure pattern produced by various pressure-breathing apparatus has real influence on the degree of circulatory effect produced There is general agreement that elevated intrapulmonary pressure diminishes cardiac output by interfering with function of the right heart It has been suggested that pressure should drop rapidly after reversal, in the beginning of expiration, decreasing quickly to or

TABLE 1 —PRESSURE RATIOS IN PRESSURE BREATHING DEVICES

Apparatus	Seconds		Ratio	Seconds		Ratio
	Inspiration	Expiration	Inspiration Expiration	Elevated Pressure	Low Pressure	Elevated pressure Low pressure
Emerson	0 88	2 64	1 3 0	1 36	2 16	1 1 6
Jefferson 1 1 time ratio	1 76	2 24	1 1 3	2 24	1 76	1 3 1
Jefferson 1 2 time ratio	0 8	2 40	1 3 0	1 36	1 84	1 1 35
Bennett	0 72	2 64	1 3 6	1 20	2 16	1 1 8
Stephenson	1 20	3 44	1 2 8	1 76	2 88	1 1 6

near atmospheric, with a mean mask pressure during the expiratory period as near as possible to atmospheric

Ankeney and co workers agree that a negative pressure phase may augment the circulation in the intact thorax, but not in the open thorax They stated that the pressure profile that least interferes with circulation should be one third positive pressure with abrupt fall to atmospheric pressure for the remaining two thirds of the respiratory cycle

The authors studied several pieces of equipment used in pressure breathing during anesthesia from the viewpoint of intermittent positive-pressure patterns Summary of these studies is given in Table 1 Pulmonary compliance and resistance are altered during anesthesia and surgery The operator who is accustomed to bag squeezing can at least sense large deviations from normal, and endeavors to maintain

(5) Anesth & Analg 38 32 41 Jan Feb 1959

satisfactory ventilation Some apparatus, by virtue of design, make it easier to maintain ventilation under altered circumstances. The authors studied the effect of interposed resistance on pulmonary inflation by the ventilating ability of these four devices: Jefferson ventilator, Emerson controller-assistor, Bennett assister and the Stephenson controlled respiration unit. Findings are summarized in Table 2

In general, as the tidal stroke decreases elevation of intra-

TABLE 2—PERCENTAGE DECREASE IN AMOUNT OF GAS DELIVERED WITH VARYING RESISTANCE

Apparatus	Port size (mm)	Gas delivered (cc)	Decrease (percent)
Jefferson	20	650	0
Tidal volume	12	650	0
650 cc	7	550	15 3
	5	500	23
Bennett	20	750	0
Tidal volume	12	725	3 3
750 cc	7	625	16 6
	5	450	40
Emerson	20	625	0
Tidal volume·	12	625	0
625 cc	7	625	0
	5	600	4
Stephenson	20	675	0
Tidal volume·	12	675	0
675 cc	7	650	4
	5	625	8

pulmonary pressure decreases and the pressure pattern changes Thus it would seem that the more efficient the unit in delivering tidal exchange by overcoming resistance the more likely it is to produce an elevated mean intrapulmonary pressure Herein elevated mean intrapulmonary pressure reflects the improved ventilation, but this prolonged elevated pressure may have deleterious effects on cardiac output

► [The reader must not be misled into hypoventilating patients because of a fear of interfering with circulation There is reasonable evidence to indicate that interference with circulation by elevated mean intrapulmonic pressures is of significance only in circumstances in which there is an existing circulatory deficiency such as hypovolemia, myocardial insufficiency, etc —Ed.]

Mechanical Ventilators are compared by E Dean Bab-

bage, James O Elam and Robert O Bauer[6] (Buffalo) The performance of the Emerson controller resembles that of the volume-limited, pressure-variable devices, whereas the Bennett shows changes characteristic of the pressure limited, volume-variable type of ventilator As assistors these two devices present comparable features Negative-pressure expiratory phases are available with both The stroke volumes delivered by both appear on calibrated bellows Reserve pressure up to 50 cm water to act on the reservoir bellows is available with the Emerson ventilator The Bennett assistor controller has the following desirable features quiet operation, a T valve for changeover from machine to manual operation, a volume indicator on the rocker arm and a volume calibrator on the glass enclosing the accordion bellows The built in volume indicator on the rocker arm is hignly efficient The value it gave coincided exactly with the amount of ventilation as recorded on a Monaghan ventilation meter placed at the facepiece Closure of the breathing tube at the facepiece gives immediate warning that ventilation is interrupted Sufficient negative pressure is easily obtained by changing the weight on the rocker arm

The redesigned Jefferson ventilator has an accordion bellows instead of a bag within the transparent chamber This permits the anesthesiologist to observe the volume of gases being delivered to the patient Complete obstruction at the facepiece stops the excursion of this bellows All models have a T valve, permitting rapid change from ventilator to manual control

The Stephenson controlled respiration unit changes its volume less than do any of the contemporary models tested Nevertheless, the volume indicator that controls the excursion of the lower bellows is not correct Total occlusion at the facepiece can be undetected by the anesthesiologist, unless he continually observes the lower bellows Another shortcoming is that there is no provision for a quick changeover from ventilator to manual control The nipple allowing the anesthetic gases to be introduced into the "throat" between the two bellows is dangerous and unnecessary

The Morch surgical respirator has a built in volume indicator and an aneroid manometer It is the noisiest of all the machines tested Ventilation of the patient is usually

(6) New York J Med 58 2653 2657 Aug 15 1958

satisfactory, but it is difficult to obtain negative pressure.

Kinetic Resistance of Relaxed Respiratory System. According to John Butler[7] (Birmingham, England), increasing use of mechanical respirators during anesthesia and for therapeutic purposes has focused attention on the mechanics of intermittent positive-negative pressure ventilation and the importance of acquiring data on total pressure change necessary *for endotracheal ventilation of the completely re-*

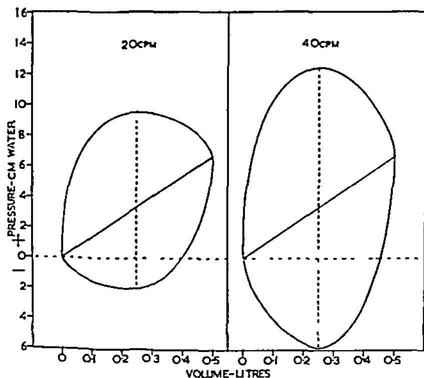


Fig 147 —Hypothetical pressure volume diagrams of airway pressure and volume changes during *endotracheal ventilation* *Hindrance pressures are mean values from* younger patients without cough, and compliance (static) pressures are means from 41 relaxed, anesthetized patients (Courtesy of Butler J Clin Sc 16 491 505, 1957)

laxed patient A simple comparative estimate of kinetic forces is obtainable by ventilating at two different rates and measuring the increase in the maximum pressure variation (total hindrance pressure) at the higher rate

Three women and 14 men, aged 21-67, were studied All had normal chests on clinical and x-ray examination though they often had slight or moderate cough, often attributed to smoking. Measurements were made in supine position with the arms at the sides Pressure variation of about 12 cm of water was necessary to ventilate these anesthetized and re-

(7) Clin Sc 16 491 505, 1957

laxed patients at 20 c/minute with tidal volume of 0.5 L and sine wave flow pattern. Total hindrance pressure in these patients was increased when compared with previously reported results obtained by ventilating unanesthetized subjects in a box respirator. Rise of hindrance pressure with increase of the ventilatory rate was about the same as that predicted from these studies on unanesthetized subjects. This suggested presence of a factor that increased total hindrance to ventilation, but did not rise as expected at the faster respiratory rates. The behavior of this structure resistance factor suggested that it was due to chest-wall hysteresis and variation in volume of ventilated lung tissue when endotracheal ventilation was practiced in these relaxed, anesthetized patients.

There was considerably greater total hindrance pressure in older patients who had cough (group 2) than in younger patients without cough (group 1). This was mainly due to larger deflationary hindrance pressure. There was no continuous association of deflationary pressure with age in either group. The deflationary hindrance pressure in older patients with cough was decreased when end deflationary volume was increased by 0.5 L (which increased airway pressure by about 5 cm in these patients) (Fig 147). This indicated that it was probably associated with passive narrowing of the airways in the deflationary phase and suggests why the anesthetist often assists ventilation by maintaining slight positive pressure in the airways.

Passive alteration in bronchial resistance in subjects with cough during the deflationary phase is probable. Wheezing of the patient with chronic bronchitis may also be due to passive and mechanical increase of expiratory resistance rather than to active bronchospastic change as is widely believed. Frequent failure of bronchodilators to relieve these patients would thus be explained.

Controlled Passive Respiration under General Anesthesia for Peroral Endoscopy, with Proposed Extension of Jackson-Huber Nomenclature of Bronchopulmonary Segments. The method described by Ira A. Polisar, E. Stewart Owre, Gert B. Bienias and Charles R. Weeth[8] (Long Island College Hosp., Brooklyn) consists essentially of intravenous use of short acting barbiturate in just sufficient quantity to

(8) Tr. Am. Acad. Ophth. 62:178-188, Mar.-Apr. 1958.

abolish the lid reflex, an ultrashort-acting muscle paralysant (succinylcholine), also intravenously, to the point of complete paralysis (apnea) and use of a mechanical thoraco-abdominal respirator that permits controlled passive respiration with the patient lightly asleep and paralyzed This type *of anesthesia, used routinely in about 250 patients, permitted* visualization of more distal bronchi than is usually possible with topical anesthesia Need for haste is eliminated, mo-

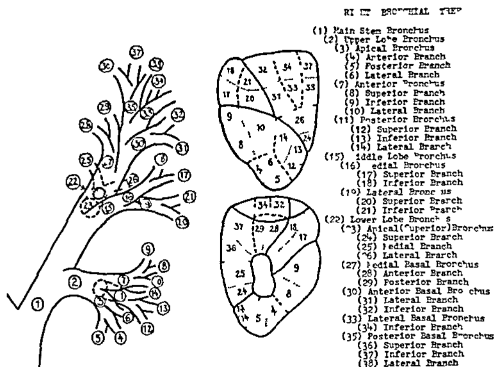


Fig 148—Nomenclature for right bronchial tree Numbers 1 2 3 7 11, 16, 19 22, 23, 27 30 33 and 35 represent Jackson Huber nomenclature All others represent proposed extension (Courtesy of Polisar I A *et al* Tr Am Acad Ophth 62 178 188, Mar Apr 1958)

tion at the head and neck is possible through wide range, normal physiologic motion of the bronchi is present and cough is absent

A bronchoscope of smaller diameter (6 mm instead of 8 mm) can be inserted into the right upper lobe bronchus and its anterior and posterior segmental orifices, into the left upper lobe bronchus and its lingular orifice, into the middle lobe bronchus and into segmental orifices of both lower lobe bronchi The 6 mm bronchoscope will admit the Broyles optical pieces foroblique, right angle and retrograde

Tertiary or segmental bronchi constitute the end po t of

the present Jackson-Huber nomenclature Beyond these the fourth order bronchi (Figs 148 and 149) The proposed extension of nomenclature has been based on endoscopic views, using the long axis of the tertiary bronchus as the reference point in naming quaternary bronchi into which it divides

Any method that permits discovery of pathologic changes

LEFT BRONCHIAL TREE

(1) Main Stem Bronchus
(2) Upper Lobe Bronchus
(3) Upper Division
(4) Anterior Bronchus
(5) Superior Branch
(6) Inferior Branch
(7) Lateral Branch
(8) Apical Posterior Bronchus
(9) Apical Bronchus
(10) Anterior Branch
(11) Posterior Branch
(12) Posterior Bronchus
(13) Lateral Branch
(14) Posterior Branch
(15) Lower(Lingular)Division
(16) Superior Bronchus
(17) Lateral Branch
(18) Inferior Bronchus
(19) Lower Lobe Bronchus
(20) Apical(Superior)Bronchus
(21) Superior Branch
(22) Medial Branch
(23) Lateral Branch
(24) Anterior-Medial Basal Bronchus
(25) Anterior Basal Bronchus
(26) Lateral Branch
(27) Medial Basal Bronchus
(28) Lateral Basal Bronchus
(29) Superior Branch
(30) Inferior Branch
(31) Posterior Basal Branch
(32) Superior Branch
(33) Inferior Branch
(34) Lateral Branch

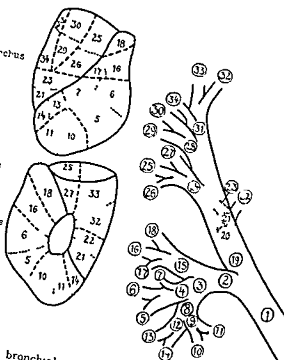


Fig 149—Nomenclature for left bronchial tree Numbers 1 2 3 4 8 15 16 18 19 20 24 28 and 31 represent Jackson Huber nomenclature All others represent proposed extension (Courtesy of Polisar I A et al Tr Am Acad Ophth 62 178 188 Mar Apr 1958)

more distally in the bronchial tree and therefore earlier in many patients, is of self evident value

► [It would be of considerable interest to know the changes that did or did not occur in saturation of the hemoglobin and the partial pressure of alveolar carbon dioxide Under the conditions of complete relaxation and a good airway the cuirass type of respirator may be reasonably effective Otherwise it has been most useful only in those circumstances in which it was used to augment spontaneous ventilation —Ed]

Elimination of Carbon Dioxide The factors involved in removal of CO_2 during anesthesia concern the patient s metabolism and respiration the performance of the breathing circuit and the anesthesiologist s management of both circulatory and ventilatory adjustments Paul N Petersen and

James O Elam[9] (Roswell Park Mem'l Inst) measured the CO_2 output in 27 adults before and during anesthesia Anesthesia was supplemented by comparable inspired concentrations of nitrous oxide, premedication in most patients included belladonna Comparative studies were made among four groups in which the following were the primary agents meperidine, pentobarbital, a combination of opiates and barbiturates, and morphine and ether

Significant decrease in the CO_2 production rate was observed in the meperidine and pentobarbital series The combined use of meperidine, thiopental, morphine and nitrous oxide produced severe central respiratory depression and concomitant decrease in CO_2 output Significant increases in output were consistently observed with ether despite increases in the alveolar concentration of CO_2

If it is conceded that any patient can be overdosed with a potent depressant drug, the contention is that it is possible to induce surgical anesthesia after meperidine belladonna premedication by either meperidine or pentobarbital and nitrous oxide without impairing the CO_2 homeostasis of many but not all patients The authors found a reduced requirement for ventilation with the decreased production of CO_2 after the use of opiates or barbiturates and conversely with ether With sufficient meperidine or pentobarbital dosage (and 70% nitrous oxide) to anesthetize good-risk adult patients for minor surgical procedures, not requiring relaxants, the expected reduction in CO_2 production is of the order of 15 30% of the preanesthetic rate Accordingly, the patient would require 70 85% of his basal ventilation, assuming nonrebreathing of CO_2 Attainment of satisfactory anesthesia without undue impairment of CO_2 homeostasis requires that the dosage schedule of intravenous agents be individualized For meperidine, a dosage which does not reduce the respiratory rate below 14/minute is a safe rule of thumb, particularly when the anesthesiologist does not assist the patient s ventilation

Possible Causes of Prolonged Apnea after operation are listed by W D M Paton[1] (Royal College of Surgeons, England) as moribundity, overanesthesia, underventilation,

(9) Anesth & Analg 37 91 106 May June 1958
(1) Anaesthesia 13 253 268 July, 1958

overventilation, afferent stimulation, afferent paralysis, central action of drugs and *prolonged neuromuscular block* Apnea should not be treated by use of a drug unless there are clear indications for it and the choice of drug is specific When serious uncertainty arises, the wisest course is to use conservative treatment and to avoid complicating an already difficult picture

Paton suggests several investigations that might help to clarify the situation Although analysis of a heterogeneous collection of case histories is often not completely rewarding, this task needs to be undertaken in an effort to elicit predisposing factors and possibly to exclude otherwise plausible explanations for this complication In most reported cases of prolonged apnea there has been uncertainty as to whether respiratory failure is of peripheral or central origin The required information could easily be obtained if use was *made of some small portable stimulator connected to an* electrode applied to suitable motor nerves through the skin surface Faradization therapy has developed considerable experience of points at which the motor nerve to a muscle can be stimulated fairly selectively Re-examination of this experience by anesthetists could furnish a useful weapon It would be more elegant to obtain a recording of muscle tension or action potential, but this is hardly practical for everyday anesthetic use A shrewd observer can make a reasonable estimate by eye of the extent of paralysis of a standard muscle

Possibility that d-tubocurarine and perhaps other relaxants have central effect should be testable by EEG This would not be possible on all patients, but it should be feasible to have a reasonable number of subjects under various operative conditions receiving typical relaxants and to test whether any convulsive or depressant effects attributable to the relaxant appear

A final possibility is that of analyzing excretory products *in the urine, e g, if it is suggested that prolonged action* by d-tubocurarine is due to failure to eliminate the drug, then it should be possible to show that a smaller amount has been excreted than normally Similar analyses could be extended to all muscle relaxants now used Studies of the pharmacodynamics of d-tubocurarine should throw light on considerably more than the question of prolonged apnea

► [Since patients these days are so often bombarded with a "shotgun" type of anesthetic process the reader will do well to heed the excellent advice of the author and avoid exposing the helpless patient to a similar barrage of drugs during his attempts to recover.—Ed.]

Effects of Apnea, Endotracheal Suction and Oxygen Insufflation, Alone and in Combination, on Arterial Oxygen Saturation in Anesthetized Patients were studied by Antonio Boba, John J Cincotti, Thomas E Piazza and Charles M Landmesser[2] (Albany, N Y) Apnea of 1 minute's duration and apnea with endotracheal suction of the same duration produced a high degree and incidence of arterial oxygen desaturation The range mean and median values were close for the two groups Statistical comparison of the means revealed no significant difference These findings tend to support the impression that catheter suction of the distal trachea through the usual large-bore endotracheal tube is a U-flow phenomenon interrupted only by the capture of secretions

In endotracheal suction carried out through a large unobstructed endotracheal tube, very little air was aspirated from the lungs

When statistical comparison was made between the groups of patients in whom oxygen was insufflated and those in whom no insufflation occurred, a high degree of significance was found The idea that oxygen insufflation will maintain adequate arterial oxygen saturation in the apneic patient is not new It was surprising to observe, however, how little oxygen insufflation was needed to maintain adequate arterial saturation in presence of simultaneous endotracheal suction

If arterial oxygen saturation of 93% is considered critical, endotracheal suction does not significantly contribute to arterial oxygen desaturation, and a small amount of oxygen insufflation offers adequate protection

It is unlikely that the observed decrease in arterial oxygen saturation was secondary to diffusion anoxia Diffusion anoxia required that the patient be sufficiently denitrogenated and that room air be inhaled to dilute the mixture present in the alveolar space Neither factor obtained in the authors' study

In these studies, apnea was a constant factor, suction was continued over 1 minute, the suction tip was free and the

(2) J Lab & Clin Med 53 680 685 May 1959

major airways were unobstructed Two major hazards of endotracheal suction in routine clinical practice are the possibility of wedging the tip of the catheter into one of the lesser bronchi or clamping of the vocal cords around the suction catheter The obvious consequence of the first possibility would be failure to remove secretions at large and possibly atelectasis of that particular portion of the lung The second possibility presents the same hazards, but on a somewhat larger scale Under these conditions, use of a double-lumen catheter for simultaneous suction and oxygen insufflation offers some tangible and practical advantages

CIRCULATION

Microcirculatory Derangements as Basis for Lethal Manifestations of Experimental Shock were studied by Benjamin W Zweifach[3] (New York Univ -Bellevue Med Center) In the shock syndrome the intestinal tract and the liver are involved in the decompensatory trend leading to irreversibility The hepatorenal hypothesis, by its very nature emphasizes the importance of functional changes in the liver Protracted shock leads to disturbances of liver metabolism, manifested by extensive changes in blood chemistry elevated uric acid levels, increase in blood iron and, in support of the primary thesis of the hepatorenal concept, liberation of the iron bearing protein ferritin Viviperfusion of the liver protects the animal against shock When the liver circulation was arterialized by anastomosing the portal vein with the renal artery the irreversible aspects of severe hemorrhagic shock were avoided The fact that blockade of the Kupffer elements of the liver abrogates all forms of tolerance further confirms the importance of this organ system to the over-all response to shock

The "gut factor" in the shock reaction represents these elements (1) bacteria are present in the lumen of the bowel and can give rise to toxic products (2) the intestinal wall sets up a local defense barrier which normally does not permit bacteria or their products to enter the circulation, (3) systemic distribution of these toxic agents occurs via the

(3) Brit J Anesth 30 466 484 October 1958

blood and lymphatic system, (4) local tissue damage results from the combined effect of stagnant hypoxia and superimposed endotoxemia.

Autonomic blocking drugs prevent the congestion and hemorrhage of the gut regularly present in control animals after shock by modifying extreme vasoconstriction during the compensatory phase of the syndrome and by blocking vasotoxic effects of bacterial products or endotoxins. The wall of the gut in animals treated with chlorpromazine shows little or no vascular damage despite an attendant bacteremia.

Different forms of tissue damage, including protracted hemorrhagic shock, lead to increased proteolytic activity of the blood. Increased proteolysis exaggerates the endotoxin reaction and by itself leads to various forms of vascular damage. There is evidence that animals, primed with various adaptive regimens, maintain their blood proteolytic activity at normal levels and thereby may be protected against many of the lethal manifestations of shock.

The microcirculation shows two discrete phases of behavior in response to both hemorrhage and trauma. Initially, the small blood vessels go through a phase of increased vasomotor activity coincident with a heightened sensitivity and selective restriction of blood flow to the most central, direct channels. Provided the blood pressure does not fall below critical levels the animal is readily restored to normal by blood replacement.

Humoral agents are conceded to be the most important mediators of the compensatory readjustment within the tissues proper. When the hypotension persists for several hours or more the initial pattern of response is gradually replaced by a decompensatory tendency. Irreversibility is uniformly associated with the full quota of decompensatory activities.

Vascular decompensation exhibits the following stigmas: (1) progressive sequestration of blood from the active circulation, (2) considerable fall in oxygen tension in the tissue proper, (3) a steadily rising hematocrit, (4) inability to sustain hypotensive blood pressure levels without continuous blood replacement, (5) vasotoxic or inhibitory principles in the blood stream, (6) gradual loss of reactivity in muscular arterioles and precapillary sphincters in visceral tissues, (7) failure of blood transfusion to improve the microcirculation.

except for a short period, (8) labored, diaphragmatic respiration followed by (9) respiratory arrest, presumably of central origin, (10) cardiac arrhythmia and arrest

The efficacy of blood replacement measures is reflected by their ability to restore the microcirculation in visceral tissues Thus, under conditions leading to irreversibility the infusion of blood or blood substitutes results in a transient, mechanical improvement of blood flow through the capillary bed, with the added blood serving to distend the atonic arterioles and venules

The basic importance of the functional state of microcirculation with respect to the ultimate outcome can best be illustrated by experiments in which increasingly severe episodes of hemorrhage were used to induce shock Three categories of peripheral circulatory collapse can be induced Acute, massive loss of blood is represented by a syndrome in which the capillary bed as an organic unit remains unimpaired Collapse of the circulation was a direct consequence of excessive vasoconstriction of the large blood vessels and the mechanical failure of blood to reach the tissues This condition is readily reversed by blood replacement

A second or intermediate type of shock can be obtained with graded hemorrhage By this procedure, animals were maintained in a given state of hypotension for selected periods The initial compensatory changes characteristic of blood loss per se are progressively lost and replaced by compensatory alterations Blood, trapped in the capillary bed and in the small veins, serves to intensify the already severely reduced blood volume With time, vascular decompensation predominates along with onset of irreversibility

A third, or toxic type of shock can be obtained regularly by superimposing the deleterious effect of anesthetic agents, such as ether or pentobarbital, bacterial products, adrenal insufficiency, etc The initial compensatory responses of the peripheral vascular bed are only poorly developed and much less effective Evidence of endothelial pathology appears in visceral tissues, coincident with stasis and hemoconcentration This form of shock is uniformly refractory to blood replacement measures

Vascular Responses to Carbon Dioxide during Anesthesia in Man L McArdle and I C Roddie[4] (Belfast) point out

(4) Brit J Anaesth 30 358 366 August 1958

that inhalation of 30% CO_2 for 1-2 minutes causes a striking increase in resistance to blood flow in the extremities, mainly in the skeletal muscles and largely mediated through vasomotor nerves This is accompanied by marked rise in systolic, diastolic and pulse arterial pressure

The authors studied the effect of general anesthesia on these responses in young women who had minor gynecologic operations When the patients were deeply anesthetized, CO_2 inhalation caused no change or a fall in forearm vascular resistance This was not because depression of the respiratory response to CO_2 with anesthesia led to less CO_2 being taken up by the lungs than in the conscious patient Fall in the arterial blood pH during 30% CO_2 inhalation was similar in the conscious and anesthetized patients Other circulatory reflexes, such as forearm vasodilatation in response to change in posture, were greatly reduced or abolished The results would imply that nervous and humoral components of vasoconstriction with hypercapnia depend on normal functioning of the nervous system

It has long been postulated that CO_2 exerts two actions with opposite effects on peripheral vascular tone, a direct action, causing vasodilatation, and an indirect action due to direct and reflex stimulation of vasomotor centers, causing vasoconstriction When the central nervous system is intact, the indirect action is dominant The present results could be explained by the hypothesis that general anesthesia had so depressed reflex activity that direct action of CO_2 became dominant, causing a fall in vascular resistance due to local vasodilatation

A large transient vasodilatation occurs in the forearm within a few seconds of stopping CO_2 inhalation, similar to that in the dog leg when artificial respiration is started after apneic diffusion oxygenation The exact mechanism of this vasodilatation is obscure through it seems related to a rapidly falling P_{CO_2} in the arterial blood Even after vasomotor nerves to the forearm have been blocked, after vasodilatation still occurs General anesthesia, which greatly depresses reflex vasoconstrictor response to hypercapnia, is without any noticeable effect on after vasodilatation It would appear therefore that a humoral mechanism, related in some way to the rapidly falling arterial P_{CO_2} is involved

Though anesthesia may protect the patient from dangers

of the pressor response to CO_2 inhalation because this is largely mediated through the nervous system it may not greatly modify the dangers of the posthypercapnic state during which shock and cardiac irregularities may occur

Pressor response to CO_2 was greatly reduced or abolished by deep anesthesia Arterial pressure never fell in the anesthetized patient during CO_2 inhalation even when there was pronounced fall in forearm vascular resistance

Hypercapnia caused bradycardia in the conscious patient but this effect was reversed under deep anesthesia Possibly this reversal was partly due to general depression of the reflex activity by the anesthetic drugs because other reflexes affecting heart rate were depressed During deep anesthesia increase in heart rate with carotid compression was greatly reduced or absent

Although assessment of ventilation was crude most of the experiments confirmed that general anesthesia depresses respiratory response to CO_2 inhalation However depression of respiratory responses seemed less pronounced than that of vascular responses

Accumulation of CO_2 in the body is not infrequent during general anesthesia Many factors such as the respiratory depressant effect of anesthetic drugs increase in respiratory dead space increased use of muscle relaxants inefficiency of artificial ventilation and use of hypothermia may be responsible for the resultant hypercapnia It has been suggested that some of the cardiovascular complications that may accompany anesthesia are due in part to altered CO balance Present experiments show that general anesthesia may greatly modify the normal cardiovascular responses to hypercapnia and this should be borne in mind when cardiovascular changes during anesthesia are being attributed to changes in CO_2 elimination

► [Unfortunately the authors give the impression that the changes observed occur with all types of inhalation anesthesia Actually the observations were made only with a combination of thiopental nitrous oxide and ether It appears furthermore that there was not a steady state As a result even though the data are interesting it is difficult to determine *their applicability to the clinical situations mentioned* —Ed]

Studies on Renal Vasoconstrictor Responses Antonio Bobo Samuel R Powers Jr and Arthur A Stein (Albany N Y) observed a high incidence of postoperative renal dys

(5) Anesthesiology 20 268 276 May June 1959

function during their early experience with excision of abdominal aortic aneurysms under conventional anesthesia Further experience showed that this complication can be prevented by use of a ganglionic blocking agent during the period of aortic occlusion. The possibility that the prevention of some vasoconstrictor phenomena might be responsible for this occurrence was supported by experimental reports that a pathologic picture similar to the one observed

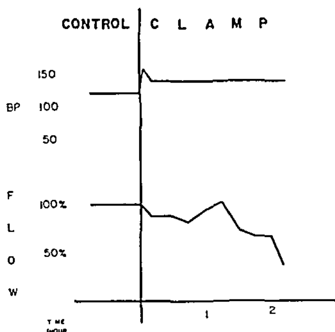


Fig 150—Arterial blood pressure and renal blood flow changes after clamping of abdominal aorta Blood pressure is recorded in millimeters of mercury and renal flow as percentage of control values Note profound drop in renal flow unmatched by comparable drop in blood pressure (Courtesy of Boba A *et al* Anesthesiology 20 268 276 May June, 1959)

by the authors may be secondary to local vascular disturbances The high incidence of renal dysfunction noted after body trauma and the generalized vasoconstrictor response to experimental and clinical trauma suggested that vasoconstriction may be the underlying factor common to both entities

The authors evaluated by laboratory means the role of renal vasoconstrictor responses in the production of renal pathologic changes Clamping the abdominal aorta of mongrel dogs just distal to the renal arteries decreased renal blood flow, which was associated with increase in renal vascular resistance (Fig 150) These immediate changes were associated with late histopathologic changes compatible

with an acute ischemic episode and morphologically similar to human, distal tubular necrosis Acute mechanical denervation of the kidney prevented immediate renal hemodynamic alterations, and pharmacologic denervation (ganglionic blockade, Fig 151) modified favorably the immediate changes and late histopathologic manifestations

Limited trauma to 1 hind limb produced immediate and late renal manifestations similar to those observed after

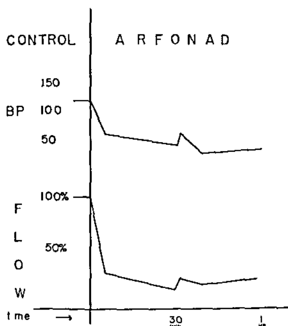


Fig 151 —Arterial blood pressure and renal blood flow changes during administration of ganglionic blocking agent Note that the two parameters follow roughly parallel patterns Occlusion of abdominal aorta after ganglionic blockade did not alter this course of events (Courtesy of Boba A *et al* Anesthesiology 20 268 276 May June 1959)

aortic clamping Ganglionic blockade used immediately after trauma favorably modified immediate and late renal changes

In the kidney, it is possible to produce vasoconstrictor responses that result in histologic damage Prevention of the constrictor response modifies favorably this course of events

Are there other vital areas where similar vasoconstrictive responses occur and to the same extent? The answer to this question might modify our entire therapeutic approach In hemorrhagic shock a similar problem exists Though the recommended clinical approach is maintenance of maximal vasoconstriction by exogenous pressor substances, the experimental evidence in the laboratory points out that their use

does not increase the survival rate When an attempt is made at suppressing the vasoconstrictor response to hemorrhage, an increase in the survival rate is observed

Reserpine and Vascular Tone Basic researches described by J H Burn[6] (Oxford Univ) have shown that reserpine is a valuable tool for analyzing factors that control vascular tone It has been learned that the store of noradrenaline and adrenaline present in the heart and blood vessels is not inert, but that certain substances, such as nicotine and many sympathomimetic amines, release noradrenaline from it and that in the heart there is normally a release not due to any known agent The store of noradrenaline controls sensitivity of the organ to noradrenaline reaching it via the sympathetic nerves or via the blood stream, and the store can be replenished from the blood stream

Diminution in sensitivity to noradrenaline occurs in a normal animal when intravenous infusion of norepinephrine is given Sensitivity of the vessel wall appears to depend on the size of the store of noradrenaline present in the wall Because sympathetic nerves act by liberating noradrenaline, sensitivity of the vessel wall to sympathetic impulses depends on size of the store of noradrenaline present in the wall When the store is large, as after intravenous infusion of norepinephrine sensitivity of the wall to sympathetic impulses is low, and for this reason abrupt fall of blood pressure occurs when the intravenous drip of norepinephrine is stopped

The practical suggestion that emerges from this is that when a patient's blood pressure has been maintained for some time by intravenous drip of norepinephrine, and when alarming fall in blood pressure occurs on stopping the drip, the correct procedure then is not to restart the drip, but to give an injection of ephedrine, which causes discharge of noradrenaline from the store in the vessel walls Ephedrine acts like Tyramine and phenylethylamine as an adrenaline liberator and its effect is greatest when the store in the vessel walls is greatest But ephedrine is more suited for injection in these circumstances than is Tyramine or phenylethylamine because these two substances are soon destroyed by amine oxidase Ephedrine having a methyl group on the alpha carbon atom, cannot be destroyed by amine oxidase

(6) Brit J Anaesth 30 351 357 August 1958

and therefore goes on acting for a much longer time

It is always risky to assume that what happens in the cat or dog will also happen in man, but the assumption in this instance seems justifiable

► [If this is applicable to man, it is something to remember in circumstances in which it becomes difficult to wean a patient from a continuous drip of norepinephrine —Ed]

Comparison of Vasopressor Responses in Presence of Phenothiazine Derivatives G W N Eggers, Jr, Gunter Corssen and Charles R Allen[7] (Univ of Texas) point out that the sedative and tranquilizing actions of phenothiazine compounds make them desirable for preanesthetic medication They afford psychic sedation, reduce the total amount of narcotics and anesthetic agents needed and decrease secretory activity, nausea and vomiting Phenothiazine compounds depress the ascending reticular system, which results in a reduction of central reflex activity, including the normal response to stress There is reduction of myocardial irritability by these drugs, due partly to their local anesthetic action When this action is desirable, mepazine offers the most promise Hypotension is often noted when chlorpromazine is administered and to a lesser degree with other phenothiazines The appearance of hypotension is alarming, but more distressing is the inability to combat this hypotension with standard vasopressors

The authors compared the effects of promethazine, mepazine and chlorpromazine on vasopressor response in dogs Epinephrine, norepinephrine, methoxamine and phenylephrine were the vasopressors studied Response was remarkably consistent in all the dogs The effective blood pressure raising ability of epinephrine was slightly diminished in presence of promethazine and mepazine (Fig 152) The epinephrine reversal effect in the presence of chlorpromazine was noted in all the dogs The effective blood pressure-raising ability of norepinephrine was not appreciably diminished in the presence of promethazine, mepazine or chlorpromazine Pressor response increased slightly in the presence of mepazine and chlorpromazine, probably because of a depression of baroreceptor reflexes *The effective blood* pressure-raising ability of methoxamine was diminished by all phenothiazine derivatives, particularly chlorpromazine

(7) Anesthesiology 20 261 267 May June 1959

The ability of phenylephrine to raise blood pressure was also diminished by all the phenothiazines, particularly chlorpromazine.

The duration of action of epinephrine and norepinephrine was not appreciably affected by the phenothiazines studied.

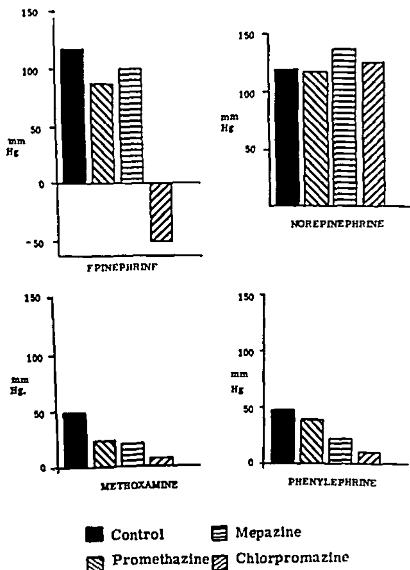


Fig 152—Average blood pressure raising ability of epinephrine, norepinephrine, methoxamine and phenylephrine in controls and in presence of promethazine, mepazine and chlorpromazine (Courtesy of Eggers, G W N, Jr, *et al* Anesthesiology 20 261 267, May June, 1959)

Average duration of action of methoxamine and phenylephrine was reduced in the presence of mepazine and markedly so in the presence of chlorpromazine Promethazine did not decrease the duration of phenylephrine activity, but did de-

crease that of methoxamine Intravenous phenothiazines produced sudden though transient fall in arterial blood pressure and tachypnea that persisted even after the pressure returned to preinjection levels The most rapid return of blood pressure to preinjection level was usually noted with use of mepazine

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INHALATION ANESTHESIA

Nitrous Oxide Hypalgesia in Trained Subjects F P Haugen, W J Coppock and H C Berquist[8] (Univ of Oregon) studied the effects of various concentrations of nitrous oxide on the thresholds for electric stimuli applied to filled teeth Nine subjects without previous experience with nitrous oxide were tested and gas concentrations of 25%, 30%, 40% and 50% were used The absolute threshold was the point at which the stimulus was just felt, and the avoidance threshold was at an intensity where just-tolerable pain was noted The two thresholds ran parallel courses with no indication that the painful quality of the stimulus disappears without concomitant change in the absolute threshold

In a conventional induction during inhalation anesthesia, consciousness is lost rapidly, but in the authors' experiment the first stage was prolonged with no deliberate intent to produce unconsciousness The person experiencing the effects of the gas was usually aware of a terrific pounding in the ears, far faster in tempo than the heartbeat The sound seemed to engulf everything, though all sounds seemed exaggerated in volume If the pounding could be disregarded, he was aware of a delightful warmth sweeping over his body A flight of ideas and thoughts was experienced with a compelling urge to transmit them, but which were usually forgotten when full consciousness returned Sometimes the test subject had difficulty in restraining himself physically or vocally, but most succeeded The stimulus to the tooth broke into the delirium and alerted the subject into signalling with the key He was sure that he was far from accurate in the response to the stimulus and often frantically pressed

(8) Anesthesiology 20 321 324 May June 1959

the key as though afraid the intensity would be increased before he could signal

An unexpected result of the testing was the influence of learning on the effects of nitrous oxide With one exception, no more than five test runs were required before the subject learned to discriminate the stimulus from the general state of mental confusion resulting from the inhalation of the gas This variable has not been taken into account in some of the earlier studies The factor of learning, together with the close correlation between the absolute threshold and the avoidance threshold, lead to the conclusion that an interpretation of the term "nitrous oxide analgesia" must be elastic enough to include the part played by confusion It cannot be assumed from these tests that nitrous oxide produces a state of analgesia comparable to that observed in patients to whom a moderate, but effective, dose of morphine has been administered

► [Another example of the confusion surrounding the states of 'analgesia,' 'anesthesia," 'sedation" etc —Ed]

Cyclopropane Anesthesia—*I Cardiac rate and rhythm during steady levels of cyclopropane anesthesia at normal and elevated end-expiratory carbon dioxide tensions*—A study of 31 healthy persons was made by A A Lurie, R E Jones, H W Linde, M L Price, R D Dripps and H L Price[9] (Univ of Pennsylvania) Responses to experimental variables of cyclopropane and CO_2 tensions were not influenced by drugs given before anesthesia (opiates, barbiturates or belladonna derivatives) nor by reflexes or alterations in function secondary to operation Observation was prolonged and many data were recorded continuously Concentration of cyclopropane in end expired air was maintained constant within 1 vol %

Cardiac arrhythmias occurred rarely, provided alveolar P_{CO_2} was normal and arterial blood concentration of cyclopropane was below 19 mg/100 ml When ventricular extrasystoles were present before induction of anesthesia, they disappeared or were reduced in frequency immediately after induction Arrhythmias that occurred during anesthesia in the absence of purposeful P_{CO_2} elevation consisted of 1st degree heart block, wandering pacemaker, atrial extrasystoles or fibrillation, complete heart block, atrioventricu

(9) Anesthesiology 19 457 472 July Aug 1958

lar nodal rhythm, atrioventricular nodal extrasystoles and ventricular extrasystoles from one or more foci, including multifocal ventricular tachycardia Usually the arrhythmias were impure, changed from one type to another and often reverted to normal sinus rhythm during apparently unchanged conditions

When end expiratory Pco_2 was normal or subnormal (20-43 mm Hg), cardiac arrhythmias occurred in 19 of 29 subjects, with nodal rhythm and ventricular extrasystoles predominating Cardiac arrhythmias appeared, on the average, once in every 100 minutes of anesthesia, persisting for 5 min utes Beats originating in the sinoatrial node were often present with those of abnormal origin

When end-expiratory Pco_2 was normal or subnormal and end-expired or blood cyclopropane concentration had been maintained constant for 15 minutes or more, most (80%) arrhythmias were of atrioventricular nodal or ven tricular origin or both Incidence of both types increased rapidly at arterial blood cyclopropane concentrations above 15-20 mg/100 ml, but at any particular cyclopropane concentration incidence of ventricular rhythms was below that of nodal rhythms When ventricular extrasystoles were occurring, interspersed beats of supraventricular origin were initiated from the atrioventricular node in 6 of 9 patients Mean cyclopropane concentration at which arrhythmia appeared for the first time was 25 9 ± 7 1 (S D) mg/100 ml The corresponding mean Pco_2 was 33 3 mm Hg

In 9 subjects supraventricular arrhythmias developed on 12 occasions during anesthesia when end expired Pco_2 was normal or subnormal The average heart rate before induction was 74 6 contractions per minute The average rate during anesthesia when cardiac rhythm was normal was 70 7 for the whole period of normo or hypocapnia and 67 4 pre ceding development of arrhythmia The average rate during supraventricular arrhythmias was 68 5 Corresponding data from 9 subjects in whom ventricular extrasystoles de veloped on 10 occasions were 74 4, 67 3 and 82 3 The difference between the last two was highly significant Increase in rate appeared attributable to addition of ventricular ectopic beats to those of supraventricular origin

Supraventricular arrhythmias were neither preceded nor followed by statistically significant change in arterial blood

pressure In contrast, ventricular arrhythmias were preceded by significant increase The averages corresponding to the periods mentioned were 120/77, 131/84 and 133/79 mm Hg

Arrhythmias occurring during hypercapnia were identical with those during normocapnia, but the appearance rate was greater, averaging 4 5/100 minutes, and abnormal rhythms occupied over 60% of the time during which P_{CO_2} was elevated There was no evidence that hypercapnia significantly affected incidence of supraventricular arrhythmias Ventricular extrasystoles were relatively more numerous than during normocapnia and were present in 83% of the total number of arrhythmias observed

There was no subject in whom a ventricular arrhythmia could not be produced by elevating the P_{CO_2}, but the level at which arrhythmia appeared varied considerably from subject to subject "Threshold" values for P_{CO_2} ranged from 44 to 107 mm Hg, with mean of 74 mm Hg Average blood cyclopropane concentration at the P_{CO_2} threshold was 18 mg/100 ml (range 8-30) There was no apparent relation between occurrence of arrhythmias and type of respiration (spontaneous or controlled) present at the time Individual differences in threshold could be attributed largely to the cyclopropane concentration in arterial blood Mean heart rate during ventricular arrhythmias induced by hypercapnia was significantly decreased to 93 2/minute

On 28 occasions end expiratory CO_2 tension was decreased rapidly to normal from levels of 53 104 mm Hg In 2 of 8 subjects with sinus rhythm at the start ventricular arrhythmias developed as P_{CO_2} decreased In 16 of 20 subjects with ventricular arrhythmia during hypercapnia, this reverted to sinus rhythm as P_{CO_2} approached normal levels Ventricular arrhythmia worsened in 4 subjects (greater frequency of ventricular extrasystoles or appearance of more ectopic foci) Arrhythmias observed during declining P_{CO_2} did not differ from those observed during hypercapnia or deep cyclopropane anesthesia In the group with arrhythmia, the rate of fall of P_{CO_2} and initial P_{CO_2} were significantly higher than in those without arrhythmia All arrhythmias disappeared within 5 minutes and only in 7 of the 28 instances did hypotension develop to 80 mm Hg systolic or below This degree of hypotension was transient occurring

in only 3 of 6 patients in whom arrhythmia developed In no instance did ventricular fibrillation or asystole occur

These data indicate that cyclopropane per se can initiate ventricular arrhythmias in normal man not subjected to operation, even if there is normal oxygenation and elimination of CO_2 Incidence of arrhythmias increases rapidly with increasing cyclopropane concentration If P_{CO_2} is permitted to increase above normal levels during cyclopropane anesthesia, ventricular arrhythmias will occur in every istance if the degree of respiratory acidosis is sufficient Ventricular arrhythmias may appear or worsen if elevated P_{CO_2} is reduced and likelihood of this increases with greater rates of fall and with higher blood cyclopropane concentrations

II Epinephrine and norepinephrine in initiation of ventricular arrhythmias by carbon dioxide inhalation —H L Price, Lurie, Jones, M L Price and Linde[1] found that an increase in alveolar P_{CO_2} precipitated ventricular arrhythmias in each of 28 human subjects anesthetized with cyclopropane

Intravenous infusions of epinephrine and/or norepinephrine at rates of 4-26 µg /minute produced similar arrhythmias in 6 of 8 subjects Ventricular arrhythmia could not be produced in 1 by an infusion of epinephrine at the rate of 12 µg /minute or in another by 26 µg /minute norepinephrine

The concentrations of epinephrine and norepinephrine in arterial plasma during periods of arrhythmia were much greater when the arrhythmia was produced by infusion than when it was caused by hypercapnia This suggests that an increase in circulating catechol amines was not the cause of the arrhythmias Atropine did not appreciably affect the ability of hypercapnia to initiate ventricular arrhythmias

Bilateral blockade of the stellate ganglions with local anesthetic rendered hypercapnia practically unable to produce ventricular arrhythmias but did not significantly alter the ability of infused epinephrine or norepinephrine to do so The effect of blockade of the stellate ganglions in preventing arrhythmias was not due to coincident arterial hypotension, systemic absorption of the local anesthetic drug or inadvertent vagus blockade, presumably it resulted from interruption of the sympathetic fibers supplying the heart

Reduction of elevated alveolar P_{CO_2} toward normal re-

(1) Anesthesiology 19 619 630 Sept Oct 1958

sulted in disappearance of ventricular arrhythmias, except in the few instances in which the concentrations of epinephrine and norepinephrine in arterial plasma were in the range capable of producing arrhythmias before hypercapnia was corrected and when the rate of Pco_2 reduction exceeded 25 mm/minute Hg

It is suggested that hypercapnia increases the rate of liberation of catechol amines from sympathetic nerves terminating in the myocardium and that this causes ventricular arrhythmias Amines liberated from the adrenal medulla or from other sources during hypercapnia are relatively ineffective in producing arrhythmias, either because they do not easily penetrate the myocardium or because they enter the coronary vessels only after dilution with a large volume of circulating blood

► [This is interesting material and one of the more rational interpretations of the interactions of the catechol amines and cyclopropane It is also interesting because of the traditional method of testing anesthetic drugs with challenge doses of epinepherine. Finally, it is interesting because of the relationship to the material reported by Burn in the section on Circulation —Ed]

Manual and Mechanical Control of Ventilation during Cyclopropane Anesthesia Mary R Wester, LeRoy W Krumperman, Esther M Greisheimer and James C Erickson[2] (Temple Univ) studied in 34 patients the respiratory factors that might be responsible for the appearance of cardiac arrhythmias during cyclopropane anesthesia Respiration was controlled manually in 15 patients and mechanically in 14, in 5 the control was manual in the beginning and mechanical later During such control, high blood levels of cyclopropane were compatible with adequate oxygenation, as gauged by determinations of oxygen saturation, carbon dioxide tension and pH The ECG changes interpreted as a shifting of the pacemaker toward the atrioventricular node, occurred repeatedly in 5 patients, but were not associated with any noticeable cardiac irregularity Distinctly palpable arrhythmias occurred in 2 patients, in 1 of these, spontaneous respiration had been permitted early in the anesthesia and in the other, there were indications of underlying cardiovascular instability Hyperventilation was more frequent than hypoventilation

Despite hyperventilation sufficient to produce respiratory

(2 J A M A 168 2249 2252 Dec 27 1958

alkalosis, arterial blood oxygenation may be unexpectedly low because of uneven ventilation and perfusion of the lungs. In this study, when the inspired gas mixture contained 80% or more oxygen by the Scholander analysis, the uncorrected oxygen content of arterial blood was invariably greater than the oxygen capacity, indicating considerable oxygen was dissolved in plasma. When the inspired oxygen concentration was 55% or less, the uncorrected oxygen content was less than the oxygen capacity, indicating hemoglobin unsaturation.

Anesthetic, Circulatory and Respiratory Effects of Fluothane® were investigated by Thomas K. Burnap, Stephen J. Galla and Leroy D. Vandam[3] (Harvard Med. School) in 102 patients selected at random from operating lists. Preoperative administration of analgesics and sedatives in large doses was avoided so that the pharmacologic effects of Fluothane® would not be obscured. Conventional anesthetic technics were used. Induction and emergence were in general uneventful. Fluothane® was a profound circulatory and respiratory depressant. Circulatory depression appeared to be both central and peripheral in origin and related directly to depth of anesthesia. Depression was most common and severe when a closed technic was used. Arrhythmias occurred with all technics. Respiratory depression was always present and was manifested by tachypnea, a diminution in tidal volume and elevation of end-expiratory P_{CO_2}. Metabolic studies suggested that Fluothane® interferes with glucose phosphorylating mechanisms in a manner similar to ether and cyclopropane. Evidence of direct hepatic toxicity was not found, but caution in administration of Fluothane® to patients with hepatic cellular disease is suggested.

Fluothane® is a potent and reversible anesthetic agent. The extreme potency is its greatest drawback, for special apparatus and high-flow technics are required for its safe administration. Control of respiration seems necessary More than ordinary care will be required to achieve safe results if Fluothane® is to be used routinely with conventional apparatus and technics. The advantage of nonflammability must be balanced against the greater latitude available with potent flammable agents, such as diethyl ether and cyclopropane. Since Fluothane® is used best in a semiclosed

(3) Anesthesiology 19 307-320, May-June, 1958

that the quantity of Fluothane® added to the circuit is known

The rate of disappearance of Fluothane® from a closed system was measured over 11 hours (Fig 153) The closed circuit was set up with a 2½-L bag to represent the patient Fluothane® vapor was introduced to a concentration of 2 5% in oxygen and the inflow stopped, the circuit volume being about 4 L The rebreathing bag and the patient bag were squeezed alternately to mix the gases and push them through the analyzing cell The concentrations were noted and graphically represented Apart from the intermittent squeezing of the bags for mixing, the system was not under positive pressure Calculation from this record showed that about 12 ml Fluothane® vapor/hour escaped from the circuit

A safe closed-circuit absorption technic using Fluothane® was evolved as the result of measurements obtained by use of a Liston-Becker infra-red analyzer sensitive to Fluothane® The analyzer was interposed in the closed circuit during clinical anesthesia and gave a continuous reading of Fluothane® concentration under varying conditions Oxygen at flow rate of 500 ml /minute was passed through an accurate Fluotec vaporizer emitting 3% Fluothane® vapor in oxygen This vapor was added to a closed-circuit absorption system The inspired concentration did not exceed 1 5% even if the additions were continued for up to 7 hours Controlled respiration, to assure adequate ventilation with good carbon dioxide elimination, was an advantage with this technic Fifty patients were anesthetized in this manner and the inspired concentration was monitored in 25 of these

► [Those using halothane are tempted to employ the closed circuit to diminish the cost One should be aware that significant changes in the concentration can be effected very easily in the closed system and dangerous concentrations achieved precipitously —Ed]

Fluothane® for Obstetric Anesthesia was studied by Chalom A Albert, Gail Anderson, William Wallace, Evelyn E Henley, Alan W Winshel and Solomon N Albert[5] (Dist of Columbia Gen'l Hosp, Washington) Fluothane®, a nonflammable liquid with anesthetic properties greater than trichloroethylene, does not decompose when in contact with soda lime and can be used in a semiclosed or closed absorption system Because Fluothane® is a potent anesthetic, it

(5) Obst & Gynec 13 282 284 March 1959

can also be used in open-drop technic No toxic effect on the liver has been observed with its use

The authors gave Fluothane® to 68 obstetric patients for 30 minutes or more In routine vaginal deliveries, induction of anesthesia was smooth and rapid, with a short excitation period Patients received 100 mg meperidine hydrochloride and 200 mg pentobarbital intramuscularly for sedation Fluothane® was given only intermittently to obtain analgesia and anesthesia In some instances, immediately post partum, the uterus got boggy, would not contract after administration of Pitocin® or methylergonovine and became the source of considerable postpartum bleeding

The effect of Fluothane® on the gravid uterus at term was observed under direct vision in 26 patients who had cesarean section, 18 of whom showed an atonic uterus that showed no signs of contractions after intravenous Pitocin® and methylergonovine The uterus contracted only when Fluothane® administration was interrupted and removed from the system by frequent flushing with oxygen for 3-5 minutes, followed by direct infiltration of the uterine muscle with Pitocin® In some patients, the amount of bleeding was alarming and whole blood had to be given rapidly

There was definite relationship between the uterine tonus and duration of the Fluothane® administration In some patients, excessive bleeding presented quite a problem No ill effects on the infants were noted

The effect of Fluothane® seems to depend on the duration of pregnancy Uterine tonus was not affected when Fluothane® was given as an anesthetic for curettage after abortion in the first 3 months of pregnancy

Inhibitory Action of Halothane on Contractility of Human Pregnant Uterus Mostyn P Embrey, William J Garrett and Derek L Pryer[6] (Univ of Oxford) studied uterine contractility by tocography in 10 women in late pregnancy during painless contractions and in 2 women during labor In each patient the pattern of uterine contractility was studied for control periods before and after induction of anesthesia

Premedication was with atropine Induction and maintenance were carried out with halothane and air enriched with oxygen Duration of anesthesia was 13 35 minutes, and

(6) Lancet 2 1093 1094 Nov 22, 1958

at no time was a concentration of more than 3% halothane required Most patients were maintained on 2%

In each patient halothane had a definite inhibitory effect on the contractility of the uterus, with complete or almost complete obliteration of the contractions (Fig 154) Graphically the action was most pronounced when the preanesthetic activity of the uterus was greatest, but in all instances the effect was obvious Inhibition of spontaneous uterine contractility was demonstrated in 11 patients In the other patient an oxytocin intravenous infusion was being used and an exactly similar effect on the artificially induced contractions was observed In all patients the inhibitory effect occurred rapidly after loss of consciousness and disappeared

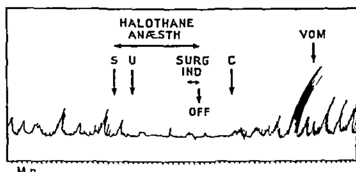


Fig 154 —Inhibition of spontaneous uterine contractility by halothane *S* start *U* unconscious *C* conscious *Vom* vomiting (Courtesy of Embrey M P *et al* Lancet 2 1093 1094 Nov 22 1958)

as quickly when the anesthetic was withdrawn Induction was easy, rapid, pleasant and rarely attended by excitement

In indicating the clear inhibitory effect of halothane on the contractility of the parturient uterus, the authors do not intend to recommend its widespread use in obstetrics But an anesthetic agent which relaxes the uterus so effectively and which may not, perhaps, have the dangers of chloroform or the unpleasant sequelae of deep ether may find a place in circumstances in which uterine relaxation is essential E g , its value might be considerable in the performance of version or other intrauterine manipulations in cases of constriction ring or when an overdose of oxytocin or impending tonic contraction threatens uterine rupture Conversely, this drug may be contraindicated where uterine relaxation is a disadvantage Severe uterine hemorrhage may attend use of halothane in vaginal delivery and cesarean section

Anesthesia with Azeotropic Mixture of Halothane and Diethyl Ether: Effect on Acid-Base Balance, Electrolyte Balance, Cardiac Rhythm and Circulatory Dynamics was studied by Allen B Dobkin[7] (Univ of Saskatchewan), with the technical assistance of Keith Drummond and Noel Purkin Halothane has some depressant effects on circulation and respiration To minimize these, Hudon and Jacques have suggested the addition of diethyl ether The authors tried to determine whether a mixture of halothane and ether produced any gross alterations in acid-base balance, electrolyte balance, cardiac rhythm and circulatory dynamics in patients undergoing prolonged operations, and whether such mixture provided satisfactory anesthetic conditions

Data were collected from 50 patients and 11 dogs The patients were premedicated with pethidine, together with atropine or scopolamine Induction of anesthesia was with a "sleep dose" of thiopental and enough gallamine to accomplish endotracheal intubation Anesthesia was then maintained in a nonrebreathing system with nitrous oxide, oxygen (2 1) and a mixture of halothane and diethyl ether (68 3 31 7 v/v) (halothane ether mixture), which was delivered from a calibrated Fluotec vaporizer Artificial respiration was provided by an automatic ventilator with fixed volume control and variable regulated pressures, set to the predetermined respiratory requirements of each patient

No disturbance was found in the acid base balance, electrolyte balance, blood sugar or blood urea nitrogen Circulatory dynamics and cardiac arrhythmias did not present the same problems as with halothane anesthesia, though dogs showed serious cardiac irregularities if epinephrine was administered during anesthesia with the mixture A smooth, stable level of anesthesia was easy to maintain with only small amounts of muscle relaxants

Since the characteristic action of halothane, like chloroform is depression of the circulation and respiration, and because the addition of ether to halothane counteracts these effects without causing any evident metabolic disturbance, this mixture warrants extensive trial However, it is essential to control the vapor concentration and to provide artificial support to pulmonary ventilation with this mixture, as with halothane, if difficulties are to be avoided It is wise

(7) Brit J Anaesth 31 53 65, February 1959

also to avoid use of epinephrine during anesthesia with the halothane ether mixture

Action of Halothane-Diethyl Ether Azeotropic Mixture on Experimental Animals was studied by J Raventos and J Dee[8] An azeotropic mixture is defined as a mixture of two or more liquids distilling over in a certain ratio at a constant boiling temperature Hudon and co workers found *that an azeotrope forms when 2 volumes of halothane are mixed with 1 volume of diethyl ether, this mixture has a* boiling point of 51 5 C and gives out vapors containing halo thane and ether in the proportion of 2 1 These authors in vestigated the anesthetic action of this azeotrope in over 1,000 patients and compared its action with the effects of halothane observed in over 3,000 patients They claim that the effect of the azeotrope, though similar to that of halo-

LOWER LIMITS OF FLAMMABILITY OF HALOTHANE ETHER AZEOTROPE AND DIETHYL ETHER

	Lower limits conc % v/v	Ether conc % v/v
Ether in O_2	2 1	2 1
Ether in 25% O_2 75% N_2O	1 5	1 5
Azeotrope in O_2	8 0	2 66
Azeotrope in 50% O_2 50% N_2O	5 2	1 7
Azeotrope in 20% O_2 80% N_2O	5 7	1 9

thane, has these advantages over halothane increase in respiratory minute volume during induction and mainte nance of anesthesia, less hypotension, less frequent cardiac irregularities and easier control with a larger margin of safety

The present authors compared the lower limits of flammability of the vapors of the azeotrope in O_2 and in $O_2 + N_2O$ with those of ether under the same conditions Results (table) showed almost no difference between the flammability of ether and that of the azeotrope present in the same proportions There could therefore be a risk of explosions in the use of the azeotrope in high concentrations, such as those needed for induction of anesthesia

Cats anesthetized with chloralose were allowed to inhale 1 06% halothane for 30 60 minutes This was followed with out a break by administration of the azeotrope in a concen tration of 1 5% for another 30 60 minutes There was no

(8) Brit J Anaesth 31 46 52 February 1959

alteration in the blood pressure, heart rate and respiratory minute volume after the change from halothane to the azeotrope mixtures Figure 155 gives details of one of these experiments

Experiments on mice revealed that concentrations of ether between 0 35% and 1 66% present in the azeotrope mixtures, which per se have no demonstrable effects when administered for as long as 2 hours, have a partially additive action to halothane

In one experiment in which spontaneous extrasystoles were recorded in a cat during azeotrope inhalation these

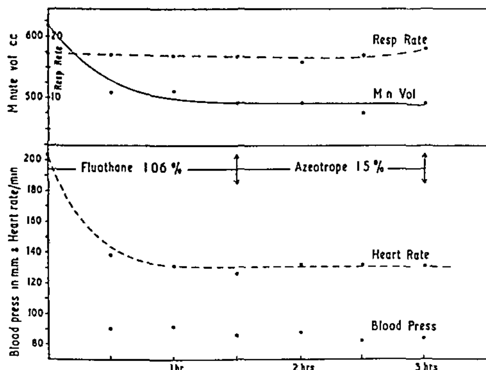


Fig 155 —Records of blood pressure heart rate respiratory rate and minute volume of cat during inhalation of 1 06% halothane and 1 5% azeotrope (Courtesy of Raventos J and Dee J Brit J Anaesth 31 46 52 February 1959)

disappeared when halothane was administered afterward It is possible that the ether present in the azeotrope produced an adrenaline discharge, which, acting on a heart hypersensitized by the halothane, reacted with abnormal con tractions

This would suggest that in some patients the ether content in the azeotrope mixtures could have a deleterious effect on hearts that are easily hypersensitized by halothane

► [The early enthusiasm for this azeotropic mixture as represented by the Dobkin Drummond and Purkin report has waned as a consequence

of such critical reports as this one and additional clinical experience of other anesthetists such as Stephen—Ed]

Performance of Absorbents: Continuous Flow was studied by Elwyn S Brown[9] (Roswell Park Mem'l Inst, Buffalo) The total quantity of CO_2 absorbed/100 Gm absorbent to the point where the absorption was extremely inefficient was determined in standard canisters for various rates of flow. The differences between these quantities for the several flow rates were directly related to changes in flow rate By extrapolation, the quantity absorbed for zero flow rate where absorption would be most complete was obtained This quantity, which is the maximum effective capacity of the absorbent, was about 80% of the theoretical capacity The maximum effective absorption capacity of 100 Gm absorbent equaled the volume of CO_2 excreted by the average adult in 1 hour

The effective absorption capacities are considerably smaller than the theoretical capacities of the absorbent Several factors could reduce the capacity of the absorbent below the theoretical (1) channeling or poor distribution of air flow could bypass active lime, (2) drying by air stream and heat of reaction could reduce activity, and (3) active absorbent may be so deep in the granule that activity of the granule is essentially zero

Some channeling occurs in the canisters used, but this is not a major reason for reduction in capacity because a number of canisters of various sizes and shapes showed little variation in their maximum effective absorption capacity

From the appearance of the exhausted granules and the uniform water content, the limitation in absorption capacity of a granule is believed related to diffusion The outside of the granule and the surface of the pores near the outside are exhausted first Thereafter absorption of CO_2 must occur deeper in the pore system The diffusion rate of CO_2 down the pores becomes a limiting factor and absorption slows At apparent exhaustion, the pores in the center of the granule still have adequate moisture and activity, *but it requires* too long a time for CO_2 to diffuse in Resting allows hydroxide ions to diffuse throughout the granule and increase its over-all activity However, the unused lime is still buried in the center of the granule and after the small amount of

(9) Anesthesiology 20 41-44 Jan Feb 1959

hydroxide ion that migrated during the rest period is used up, activity drops again

Hepatotoxicity of Inhalation Anesthetic Drugs was studied by W M Jones, G Margolis and C R Stephen[1] (Duke Univ) Various concentrations of anesthetic drugs (chloroform, vinyl ether, ethyl ether, trichloroethylene and Fluothane®) were given to 1,500 white mice by esophageal instillation Histologic studies of the liver were made 72 hours after exposure to determine hepatotoxicity All the drugs demonstrated at least minimal hepatotoxicity There were two types of minimal hepatotoxicity The earliest injury noted with the halogenated drugs was midzone fatty change in the liver lobule, which progressed to involve the central area with higher dosages This midzone change has been described as the earliest and mildest manifestation of he patic injury with chloroform With the ethers this midzone change was absent and only central pallor and vacuolation were observed

Chloroform and vinyl ether were the most hepatotoxic drugs, each producing severe, necrotizing liver changes Ethyl ether was relatively innocuous, a finding somewhat different from studies reported previously that relied on the bromsulfalein excretion test Perhaps the abnormalities of liver function reported clinically with ethyl ether are related more to its effects on metabolism in general than to specific hepatotoxic action Fluothane®, although capable of producing widespread fatty changes in the liver, failed to cause necrosis in the highest nonlethal dose used, which was 100% concentration

The results serve as an index of the degree of hepatotoxicity to be expected in man Although species differences may exist, it may be assumed that the mouse liver responds to drugs of this type in a manner similar to the human liver

Rapid onset of narcosis, together with the progressive severity of lesions noted with increasing dosages, indicated that a large percentage of the drugs was absorbed from the gastrointestinal tract This technic permitted the liver to be exposed to much higher concentrations of drugs, without causing death in the animal, than could be expected from administration by the respiratory route

Oxygen was not given during the period of narcosis The

(1) Anesthesiology 19 715 723 Nov Dec 1958

rapid metabolism and recovery to normal feeding habits of the animals would minimize the possibility that drug induced respiratory depression produced hypoxia

► [Although there still persists a feeling that halothane has a significant toxic effect on the liver, the above evidence seems convincing that the effect is minimal —Ed]

Influence of General Anesthesia on Intraocular Pressure in Man. Effect of Diethyl Ether, Cyclopropane, Vinyl Ether and Thiopental Sodium was studied by Walter Kornblueth, Leonie Aladjemoff, Florella Magora and Anwar Gabbay[2] (Rothschild Hadassah Univ Hosp, Jerusalem) Both eyes of 70 patients who were undergoing short operative procedures were examined, all the eyes were normal Intraocular pressure was repeatedly measured immediately before induction of anesthesia, after premedication with morphine and atropine, at intervals during the course of anesthesia and on recovery A Schiotz tonometer with a 5 5 Gm weight was used

Each anesthetic agent tested caused *statistically significant* decrease in intraocular pressure The decrease ranged from 5 7 mm Hg with ether to 7 0 mm Hg with thiopental sodium, as compared with average initial pressure of 17 7 mm Hg There was no significant difference in the decreases caused by the various drugs Maximal decrease in intraocular pressure occurred when deep anesthesia was reached With thiopental sodium and vinyl ether, this stage was usually reached 5 minutes after starting the anesthesia, with ether and cyclopropane, within 15 minutes

The usual variations in pupillary size with change in depth of anesthesia were found During deepest anesthesia when lowest intraocular pressure was recorded, mydriasis was most prominent In most patients, blood pressure decreased by 10 20 mm Hg during anesthesia Any respiratory disturbances during the course of anesthesia, such as cough, laryngospasm or straining, which raise venous pressure, resulted in moderately prolonged increase in intraocular pressure

All in whom such interference in smooth respiration occurred were therefore excluded from the series

Curare lowered intraocular pressure by 1 3 4 9 mm Hg, with average decrease of 2 8 mm Hg Tonography showed

(2) A M A Arch Ophth 61 84 87, January, 1959

EFFECT OF ANESTHETIC AGENTS ON INTRAOCULAR PRESSURE

	NORMAL	CYCLOPROPANE	DIETHYL ETHER	THIOPENTAL SODIUM	VINYL ETHER
No of eyes	140	20	32	78	10
Average mean pressure, mm Hg	17.7	11.4	12.0	10.7	11.6
Standard deviation, mm Hg	2.72	3.64	2.14	2.23	1.67
Standard error of mean	0.23	0.84	0.38	0.25	0.56
Differences between means of intraocular pressure					
Normal		6.3	5.7	7.0	6.1
Cyclopropane	-	—	0.6	0.7	0.2
Diethyl ether	—	—	—	1.3	0.4
Thiopental sodium	—		—	—	0.9
Test of significance of difference					
Normal	—	$P<0.001$*	$P<0.001$*	$P<0.001$*	$P<0.001$*
Cyclopropane	—	—	$0.4<P<0.5$	$0.2<P<0.3$	$0.9<P$
Diethyl ether	—	—	—	$P<0.01$	$0.5<P<0.6$
Thiopental sodium	—	—	—	—	$0.2<P<0.3$

*Statistically significant differences

30% reduction in the aqueous flow and 18% decrease in the coefficient of outflow facility after administration of curare.

A center for control of intraocular pressure has been demonstrated in the hypothalamus. The hypothalamus is depressed under general anesthesia.

T-Piece Technic in Anesthesia: Examination of Its Fundamental Principle was carried out by William Brooks, Pe-

ter Stuart and Paul V. Gabel[3] (Univ. of Rochester) by comparing resistance under conditions of constant gas flow in three T pieces with internal diameters of 1.0, 0.8 and 0.6 cm., respectively and three Y pieces of identical calibers. Gas flows used were 2-50 L./minute. The T or Y piece under test was connected to simulate the normal clinical pattern of gas flow. In each case gas inflow was kept constant at 8 L./minute. Through the limb normally connected to the patient, gas flows up to 50 L./minute were passed. No reservoir tubing was attached to the expiratory limb. Pressure readings were taken by water manometer connected to the side arm. Resistance increased with increasing flow (Fig. 156). At the maximal flow rates used, Y and T pieces

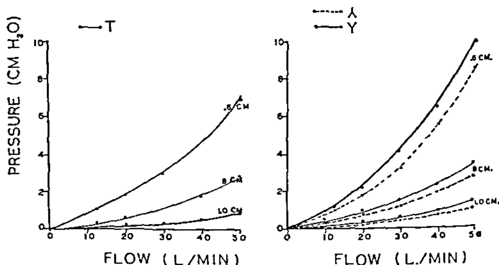


FIG 156 —Pressure recordings at constant gas flows (Courtesy of Brooks, W., *et al*: Anesth & Analg 37:191-196, July-Aug., 1958.)

of 1 cm. diameter showed pressures of 1 and 0.9 cm. water, respectively. Any reduction in diameter resulted in pronounced rise in resistance. When the Y piece was reversed less resistance was exhibited.

The most critical factor in the general formula for resistance to flow of gases through this type of equipment is its internal diameter. The relatively high gas flows necessary for satisfactory use of the T piece produced significant rise in airway pressure during expiration. Undesirable effects of such increase on respiratory and circulatory function have been well established and are precisely those which this technic was originally designed to eliminate. The

(3) Anesth. & Analg 37 191-196, July-Aug., 1958.

original specifications call for a tube with internal diameter of 1 cm, if such dimensions are adhered to, no undue rise in airway pressure can be detected Any decrease in this diameter is accompanied by increase in maximal expiratory pressure This fact appears to have been neglected by the originators of many modifications and by some manufacturers

Decreased resistance shown by the Y piece when connected in reverse position is evidence of reduced turbulence of gas flow Because of the increased velocity of flow in the smaller Y pieces this effect becomes more pronounced

Use of connectors of smaller bore than originally recommended can be viewed only with suspicion, this applies particularly to the commonly used Y piece There is no justification even in pediatric anesthesia for use of connectors with internal diameter below 1 cm

► [A useful technic, but, as is so often the case, useful only when properly applied —Ed]

Halothane and Rebreathing are evaluated by H C Newman[4] In the ideal open system, in which rebreathing is prevented by diffusion, inspiration draws gases from and expiration passes gases into reservoirs of infinite capacity A mask approaches this system more or less, depending on its construction Alternatively, inspiration may take place from a finite reservoir, e g, the cylinders of an anesthetic apparatus (via reservoir bag), whether of intermittent or continuous flow type Rebreathing may then be prevented by special valves In other systems, elimination of expired gases is achieved by the flushing effect of large gas volumes flowing during the latter part of expiration and any subsequent pause The well-known Magill system is an example of this type, but many others can be designed, e g, the T piece or the arrangement of Bullough Theoretical considerations, laboratory experiments and clinical investigations have shown that in these systems large gas flows are required to prevent rebreathing, the smaller the fresh gas flow the greater the degree of rebreathing The relationship is influenced, among other things, by the precise geometric arrangement of apparatus components More than a small amount of rebreathing is harmful and necessitates use of CO_2 absorbents

Systems that use total rebreathing are called "closed" and

(4) Brit J Anaesth 30 555 562 December 1958

the fresh gas supply is necessarily reduced to the extent of replacing gases abstracted by the patient and apparatus, viz, some 200 ml/minute oxygen and sufficient amounts of other constituents Subsequent loss of gases through the skin or wound does not invalidate this nomenclature, but significant leakage from the apparatus, whether accidental or intentional, should preclude use of the word "closed" The terms "semiclosed" and "semiopen" refer to systems between the two extremes, but, lacking precision, are perhaps best used sparingly

For greater clarity, systems are best specified by their components, their arrangement and the rate of addition of fresh constituents to the gas mixture

► [This article is included to represent another and not yet quite successful attempt to improve the nomenclature of inhalation systems—Ed]

Ether Analgesia Inspired Concentrations, Flammability and Levels in Arterial Blood were studied by Carl M Ebersole and Joseph F Artusio, Jr[5] (Cornell Univ) Twenty two unselected patients undergoing cardiac surgery were given premedication with 0 2 mg atropine sulfate and anesthetized with diethyl ether The analgesic stage was established with the patients responding to the spoken voice The EEG activity was monitored continuously, providing an objective criterion of depth The ECG, blood pressure, pulse and respiratory rate were monitored during analgesia After at least 20 minutes of stabilization in the analgesic state, samples of the inspired mixture were taken in duplicate These were taken from an outlet in the inspiratory tubing of a closed-circle CO_2-absorbing system and checked for concentration of ether Samples of the inspired mixture were tested for explosibility in the Thomas spark-ignition chamber Simultaneously 10 cc arterial blood was taken from the aortic arch by direct needle puncture, sealed and immediately refrigerated These samples were analyzed for diethyl ether concentration within 2 hours of collection

The mean concentration of diethyl ether in the inspired mixture during analgesia was 1 2 vol % The lower limit of flammability is about 2 vol % The mean arterial blood concentration during the analgesic stage was 32 mg/100 ml The air blood ratio during analgesia of up to 2 hours' duration was 1 10 The inspired ether-oxygen mixture dur-

(5) Anesthesiology 19 607 610 Sept Oct 1958

ing maintenance of the analgesic state was nonexplosive The highest concentration of diethyl ether in oxygen did not exceed 1 7 vol %

It is suggested that ether analgesia not be considered a nonexplosive technic It may become necessary at any time during the operation to increase the concentration of ether in the inspired mixture, which would immediately bring the mixture into the explosive range

Studies on Formation and Decomposition of Ether Peroxides were conducted by Julius G Shukys and Arthur H Neeley[6] (Murray Hill, N J) Most mixtures of a flammable anesthetic agent, such as ether with air or oxygen, are readily ignited by an open flame or by an electric arc or spark For all the common anesthetic gas mixtures, the Bureau of Mines has determined flammability limits, ignition energies and temperatures for spontaneous combustion

It has been suggested that ignition of anesthetic mixtures may also have occurred owing to excessive development of heat in a CO_2 absorber used during anesthesia and may have been caused by the explosive decomposition of ether peroxide Since this is largely speculative, the authors studied the temperature attained in an absorber through the heat of reaction of CO_2 and soda lime, the rate of formation of ether peroxide in a conventional vaporizer and the rate of decomposition of ether peroxide in the presence of soda lime

The maximum temperatures attained due to CO_2 absorption in a typical soda lime canister with anesthetic gas mixtures were far below the published ignition temperatures for these mixtures Heated anesthetic mixtures containing large amounts of CO_2 could safely be passed through soda lime heated far above its normal operating temperature The initial rate of peroxide formation in diethyl ether is so slow under typical conditions that ether may probably be safely used in a vaporizer for 2 days or kept in a loosely stoppered bottle for 1 week However, the rate of formation appears to increase with time, so discarding ether after these periods appears advisable

It appears unlikely that soda lime can promote peroxide formation or that it can decompose peroxides fast enough for ignition to occur Progressive accumulation of peroxides

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(6) Anesthesiology 19 671 675 Sept Oct 1958

in soda lime is impossible Ether peroxide formed in a typical vaporizer was not carried in detectable amounts to other parts of a typical anesthetic machine When usual anesthetic gas mixtures were used for a reasonable period under excessively hot conditions no peroxides were found anywhere in the apparatus

Combustion Characteristics of Anesthetics J S Lawrence and E K Bastress, Jr[7] (Murray Hill, N J) studied the combustion characteristics of cyclopropane, diethyl ether, ethylvinyl ether (Vinamar) and trifluoroethylvinyl ether (Fluoromar) Lower flammability limits were determined

LOWER FLAMMABILITY LIMITS OF 4 INHALATION ANESTHETIC AGENTS

Anesthetic Agent	Atmosphere	Lower Flammab lity Limit Per Cent Agent by Volume in Atmosphere Indicated
Ethylvinyl ether	Oxygen	2 1
Trifluoroethylvinyl ether	Oxygen	4 0
Trifluoroethylvinyl ether	Oxygen saturated with water vapor at 23 C	4 3
[illegible]		4 2
		4 0
		4 4
	water vapor at 23 C	
Cyclopropane	Oxygen	2 48*
D ethyl ether	Oxygen	2 0
D ethyl ether	Air	1 9

*This value published by the Bureau of Mines is l sted here for comparison

for ethylvinyl ether, trifluoroethylvinyl ether and diethyl ether in various atmospheres (table) The lower flammability limit of trifluoroethylvinyl ether was about twice that of the other ethers in the atmospheres tested These were compared with previously determined values for cyclopropane The influence of diluents may be noted in the variation of the flammability limit with air and oxygen Use of air was equivalent to addition of an inert diluent (nitrogen) in the ratio of 3 5 1 With each agent, change in the lower limit was small In the case of water, however, greater change in the lower limit was effected by adding a small amount of diluent This is important since gases in a closed circuit are nearly saturated

Minimum spark ignition energy was determined for mix

(7) Anesthes ology 20 192 197 Mar Apr 1959

tures of diethyl ether, ethylvinyl ether and trifluoroethylvinyl ether with oxygen and for trifluoroethylvinyl ether with nitrous oxide Figure 157 shows results with the flammability limit of each agent indicated The lower flammability limits and spark ignition energies of diethyl ether and ethylvinyl ether are nearly identical, whereas those of trifluoroethylvinyl ether are higher Substitution of nitrous

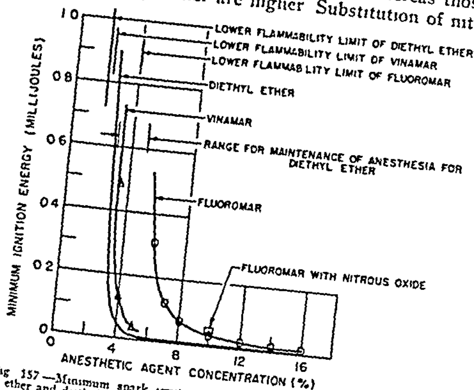


Fig 157—Minimum spark ignition energies for trifluoroethylvinyl ether ethyl vinyl ether and diethyl ether in oxygen (Courtesy of Lawrence J S and Bastress E K Jr Anesthesiology 20 192 197 Mar Apr, 1959)

oxide for oxygen with trifluoroethylvinyl ether had little effect on the ignition characteristics

With concentrations several per cent above the lower flammability limit, spark ignition energy rapidly approaches a low value that is nearly the same for all the agents At concentrations near the lower limit, ignition energy becomes high, reflecting the greater difficulty of igniting such mixtures

Maximum pressure and rate of pressure rise were determined for the three ethers with oxygen near the lower flammability limits, which are the concentrations normally used in practice Results of these tests indicated relatively minor differences between these agents Presence of a different surface, i e, contamination from previous reactions, had an

appreciable effect on results Cyclopropane, at the concentrations used for anesthesia, when ignited produced more violent reaction and might be expected to detonate

Factors Affecting Performance of Absorbents Elwyn S Brown[8] (Roswell Park Mem'l Inst, Buffalo) studied the effect of variations in the breathing pattern on the effective absorption capacity of two absorbents soda lime and Baralyme pellets At test conditions that correspond to the values in the average adult patient (500 cc tidal volume, respiratory rate of 15/minute and CO_2 production of 280 cc/minute), efficiency in relation to time was directly related to the quantity of absorbent an absorber held The Heidbrink 9-B Foregger CF no 1 and the no 2 (large) all had about the same time efficiency 3½ hours to an end point of 0 5% when soda lime was the absorbent

The rate of the terminal failure was different for each of these absorbers In the Foregger CF no 1, failure was rapid inspired CO_2 concentration rose from 0 5% to 1% in less than half an hour This terminal rise in concentration of inspired CO_2 required considerably more than half an hour with other absorbers

When Baralyme pellets were the absorbent the time efficiency was shortened 1 2 hours The Heidbrink 9 B had an efficiency rating of 3 hours, the Foregger CF no 2 (large) 2½ hours and the no 1, 2 hours to an end point of 0 5% CO_2 Terminal failure was rapid with 1% CO_2 being reached in about half an hour in each case The Foregger CF no 2 (small) failed within a few minutes with Baralyme pellets However, the absorber maintained an exit concentration of 1 5% CO_2 for over 2 hours before an additional rise in inspired CO_2 occurred

Increasing the tidal volume and reducing the respiratory rate decreased efficiency by 1½ 2 hours when tidal volume was increased from 500 to 750 cc Little or no further reduction in efficiency resulted when tidal volume was increased to 970 cc When the tidal volume and CO_2 input rate were increased while respiratory rate of 15/minute and normal CO_2 tension were maintained, significant reduction in time efficiency was observed This decrease in time efficiency was proportional to the increase in the CO_2 production rate

When the same data were analyzed to obtain the effective

(8) Anesthesiology 20 198 203 Mar Apr 1959

capacity, the effect of increasing tidal volume was again minimal with active absorbent

Evaluation of Inhalers for Trichloroethylene, Chloroform and Fluothane® is reported by S H Ngai, Henry D Green, Jack R Knox and Harvey C Slocum[9] (Walter Reed Army Med Center). The inhalers tested were the Duke, modified Duke, Emotril, Tecota Mark VI, Airlene and an experimental Tecota chloroform inhaler Vapor concentrations of the three anesthetic agents as delivered from these inhalers at different settings were measured The effect of changes in minute volume and ability of the inhalers to maintain a given vapor concentration were also tested Vapor concentration was measured with the aid of a double-beam infra-red spectrophotometer

The Duke inhaler performed satisfactorily with trichloroethylene The modified Duke inhaler allowed a gradual increase in vapor concentration with each higher setting, thus making it suitable for use with chloroform The position of the inhaler and its temperature had significant effect on the vapor concentration Except with the experimental Tecota inhaler, vapor concentration decreased when minute volume was below 6 or 8 L With the Airlene inhaler, changes in minute volume caused irregular changes in vapor concentrations All inhalers could maintain vapor concentrations well, except that with the Emotril 20-30 minutes were necessary for vapor concentration to stabilize

The modified Duke inhaler, Tecota Mark VI and the experimental chloroform Tecota inhaler were used extensively in animal experiments In dogs paralyzed with succinylcholine and ventilated with a respirator, chloroform and Fluothane® from these inhalers produced and maintained EEG patterns at levels 1, 2 or 3 for up to 90 minutes In a limited series of experiments in man these inhalers were used to administer chloroform to produce amnesia, analgesia and EEG changes to levels of 1 or 2 The longest period of chloroform inhalation was 60 minutes, the subject remained conversant and cooperative throughout Therefore these inhalers are useful for study of chloroform and Fluothane® analgesia

The role of these inhalers in anesthetic management of mass casualties would depend on several factors Applica-

(9) Anesthesiology 19 488 500 July Aug, 1958

bility and advisability of using chloroform and Fluothane® for analgesic purposes cannot be determined without further studies If use of these drugs should prove advisable, an accurately calibrated inhaler would provide a practical, relatively safe method for administration In untrained hands, an inhaler able to deliver controlled concentrations of anesthetic agents would minimize the overdosage hazard

Considerations in Design and Function of Anesthetic Vaporizers are presented by Lucien E Morris and Stanley A Feldman[1] (Univ of Washington) Vaporized liquid anes-

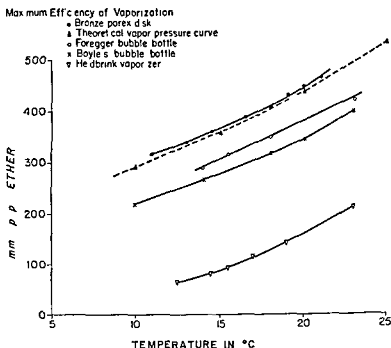


Fig 158 —Comparison of maximum vapor tension of ether produced at various temperatures by Copper Kettle Foregger bubble bottle Boyle s bubble bottle and Heidbrink wick vaporizer with theoretical vapor pressure curve for ether (Courtesy of Morris L E, and Feldman, S A Anesthesiology 19 642 649, Sept Oct, 1958)

thetic agents are still important in clinical anesthesia, either singly or as adjuvants to some other agent, such as nitrous oxide

The concentration of a vapor produced is a function of the temperature of the liquid being vaporized and the product of the total surface and time of contact at the gas-liquid interface The energy required for vaporization of a liquid must be supplied in accordance with its latent heat of vaporization If this energy is not provided from an external source the temperature of the liquid will fall, and the ten-

(1) Anesthesiology 19 642 649 Sept Oct 1958

sion of the vapor above the liquid will be reduced in proportion to the vapor pressure curve of the particular liquid Therefore, in the design of effective apparatus it is important to provide for the conduction of heat directly to the gas liquid interface If the surface of the interface is small, the gas which passes through the vaporizer must remain in prolonged contact with the liquid to approach saturation with the vapor at the particular temperature of that liquid Conversely, if the surface is sufficiently large, the time of contact becomes relatively unimportant

In the Copper Kettle vaporizer the vaporizing surface is a sintered bronze disk (Porex) which divides the gas passed through the vaporizer into a multitude of extremely small bubbles Their combined surface area is such that the time of exposure to the liquid becomes an almost negligible factor Another advantage of the Porex disk lies in the conduction of heat directly to the gas-liquid interface from the ambient atmosphere through the copper container and copper table top Perhaps the most important change made in the design of the Copper Kettle was the departure from the system which diverted a portion of the total flow of gases over the liquid to be vaporized The vernier control meters a known amount of oxygen through the vaporizer, the outflow vapor concentration of which may be 70% in the case of ether It is important to think of this "oxygen-through-ether" not as life-saving oxygen but as a lethal concentration of ether vapor which must be diluted by addition of other gases to the system Thus important principles have been combined to provide vernier control of concentration, efficiency of vaporization and moderate thermostability The superiority of the Porex disk as a vaporizing surface is shown in Figure 158 Deaths have occurred during use of the Copper Kettle The outflow of vapor concentration from the vaporizer itself is lethal unless diluted and may represent in the case of ether 50-70% concentration, depending on the temperature of the liquid within the vaporizer

Neuromuscular Blocking Action of Neomycin: Concern of Anesthesiologist; Report of Case is presented by C B Pittinger, J P Long and J R Miller[2] (State Univ of Iowa) Intraperitoneal administration of neomycin sulfate during anesthesia has been followed by prolonged, profound respiratory depression in several patients

Girl, 2, with extrophy of the bladder was scheduled for elective ureterointestinal anastomoses The day before operation 4 Gm neomycin sulfate was given orally in divided doses Preanesthetic medication consisted of 2 mg morphine sulfate and 0 2 mg scopolamine hydrobromide administered subcutaneously at 7 a m Anesthesia was induced at 8 40 a m with a mixture of nitrous oxide, cyclopropane and ether and was maintained after intubation with ether delivered with oxygen through a T tube The procedure was uncomplicated until near the end Respiration was spontaneous and unassisted Blood pressure, pulse rate and respiratory rate were maintained at about 120/90 140 and 40 respectively At 11 30 a m, just before closure, 1 Gm neomycin sulfate in 10 cc normal saline was instilled into the peritoneal cavity After closure of the peritoneum, the depth of anesthesia was allowed to decrease Progressive respiratory depression occurred concomitantly with apparent emergence from anesthesia At first respirations were assisted later artificial ventilation was necessary Apnea and flaccid paralysis were present within 20 minutes of administration of neomycin Pulse rate increased and blood pressure declined, with the onset of respiratory depression both parameters returned to previous levels during artificial ventilation which was required for 30 minutes Thereafter, shallow spontaneous respiratory movements began assistance was given for another 30 minutes before extubation There was a progressive increase in ventilatory ability with decreasing flaccidity during the next several hours Recovery was otherwise uncomplicated

Animal experiments showed that neomycin sulfate in sufficient doses produces a nondepolarizing type of neuromuscular blockade The flaccid paralysis associated with the blockade is considered adequate to explain respiratory depression This explanation does not exclude the possibility of central depression of respiration The failure of centrally acting drugs to stimulate respiration supports the contention that neuromuscular blockade, rather than central respiratory depression is the cause of apnea The blockade is

(2) Anesth & Analg 37 276 282 Sept Oct 1958

greatly potentiated in the presence of anesthetic concentrations of ether and is additive to the effects of succinylcholine Administration of calcium or neostigmine antagonizes the block

Influence of Carbon Dioxide on Neuromuscular Blocking Activity of Relaxant Drugs in Cat J P Payne[3] (Postgrad Med School, London) found that CO_2 opposed the action of suxamethonium, decamethonium and gallamine but enhanced that of tubocurarine A gradual rise, often preceded by a slight fall, in serum potassium during administration of CO_2 continued for a considerable time after administration of the gas ceased, whereas resistance to the neuromuscular block began to diminish immediately CO_2 was discontinued Thus there was no direct relation between serum potassium levels and resistance to relaxants

Among the many factors that influence biologic activity, the degree of ionization is particularly significant A change in blood pH follows ventilation with CO_2 and this change is associated with an altered response of the tibialis anterior to relaxant drugs Three of these drugs, suxamethonium, decamethonium and gallamine, have pK_a values above 13 and are therefore completely ionized with the pH range used Tubocurarine, although containing onium groups in the same pK_a range, also contains two phenolic hydroxyl groups which have pK_a values of 8 1 and 9 1 Such values are susceptible to changes in blood pH, and consequently variations in blood pH will alter their degree of ionization This may explain why the action of tubocurarine differs from that of the other relaxants

The combination of mecamylamine with cell proteins indicates another factor likely to influence the action of CO_2 on neuromuscular blocking agents The effectiveness of drugs is often modified by the binding power of proteins The intensity and duration of action of a given dose is inversely proportional to that fraction bound to protein, and alterations in plasma pH influence the ability of the plasma proteins to take up certain drugs When CO_2 is inhaled, the resulting rise in its tension in the blood raises the hydrogen ion concentration Such a reduction in pH may facilitate the combination of quaternary ammonium salts with protein, thereby limiting their activity This would explain the re

(3) Brit J Anaesth 30 206 216 May 1958

sistance to suxamethonium, decamethonium and gallamine which develops in the presence of CO_2

Influence of Certain Ganglionic Blocking Agents on Neuromuscular Transmission A R de C Deacock and T D W Davies[4] (King's College Hosp , London) investigated and compared the neuromuscular blocking effect of hexamethonium, trimetaphan and homatropinium on the rat diaphragm preparation All three drugs were capable of neuromuscular blockade, a fact not previously reported of trimetaphan or homatropinium

No initial muscle stimulation or fasciculation was seen, this probably indicates that the neuromuscular blocking mechanisms are not of the depolarizing type This is supported by the improvement in contractions that followed addition of neostigmine to preparations recovering from total hexamethonium and homatropinium block With trimetaphan, recovery from total block was halted, and the block was made more profound by addition of neostigmine In vitro, trimetaphan suppresses cholinesterase, and this may be the mechanism whereby trimetaphan upsets neuromuscular transmission This would explain the potentiation by neostigmine

The huge total of 400 mg hexamethonium was required to produce neuromuscular block in a perfusion bath of 200 ml Even after partial curarization, 250 mg was required It is unusual for more than 300 mg hexamethonium bromide to be used in anesthesia, hence, normally the curare like effect of this drug can be ignored Caution has been recommended however, in administration of hexamethonium to patients receiving mecamylamine, as this combination might produce neuromuscular block

Trimetaphan produced paralysis of the preparation after 60 mg (30 mg /100 ml) had been given, but only 20 mg (10 mg /100 ml) was required after partial curarization Clinical requirements of trimetaphan vary considerably Large amounts may be needed in resistant patients, where tachyphylaxis occurs when position of the patient does not favor production of hypotension or when coarctation of the aorta exists Doses of the order of 2,400 mg are not uncommon, and in such instances neuromuscular transmission may be depressed

(4) Brit J Anaesth 30 217 225 May 1958

The fate of trimetaphan in the body is not known, but the transient hypotensive effect of a single dose suggests rapid breakdown Only one third of the amount administered has been recovered from urine If the rest is destroyed in vivo by pseudocholinesterase, patients having a low pseudocholinesterase level would be more likely to show neuromuscular effects, particularly if relaxants or neostigmine is also given

Homatropinium produced complete block in lower dosage than trimetaphan After partial curarization only 20 mg (10 mg /100 ml) was required Doses as high as 2,280 mg have been reported in clinical use Therefore, it appears that the neuromuscular blocking effect of homatropinium may be of practical significance An advantage of this drug over trimetaphan is that its curare like effect is antagonized by neostigmine

► [Although the doses necessary to produce block seem higher than ordinarily encountered in clinical practice the observations reported emphasize the necessity for being discriminating in the polypharmaceutical approach to anesthesia —Ed]

REGIONAL ANESTHESIA

Toxicity of Local Anesthetics John Adriani[5] (Lc - State Univ) observes that untoward responses to local an thetics are local and systemic Transient or permanent age to tissues results from local toxicity The accepted d, used properly, are not locally toxic

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(5) Postgrad Med 24 95 100 August 1958

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(5) Postgrad Med 24 95 100 August 1958

adding vasoconstrictors or using dilute solutions Reactions are most frequent after topical applications to the mucous membranes

Overdosage affects the nervous and/or vascular system If the concentration of anesthetic in the blood rises abruptly and exceeds the toxic level it causes stimulation of the nervous system from above downward Excitement apprehension, disorientation, nausea and vomiting usually precede convulsions Convulsions may be controlled by drugs which depress the central nervous system Stimulation of the central nervous system may merge into a depression, which often causes apnea and circulatory failure Artificial respiration must be instituted immediately

Local anesthetics may decrease cardiac output by primarily depressing the myocardium They also cause local vasodilatation, which gives rise to varying degrees of hypotension Intravenous vasopressor agents overcome the hypotension

Not all reactions occurring during the use of local anesthetics are due to overdosage Certain patients are intolerant of local anesthetics Reaction due to intolerance is characterized by circulatory depression rather than by stimulation of the central nervous system Allergic reactions follow acquired sensitization to repeated exposures to a drug The response is of the antigen antibody type The intranasal test gives more information than the skin test

Absorption of Local Anesthetics is discussed by Donovan Campbell and John Adriani[6] (Louisiana State Univ) Reactions from local anesthetics may occur irrespective of the mode of administration They are however most common after topical application Pharmacologic data indicate that most toxic reactions from local anesthetics are associated with high plasma drug levels from rapid absorption

Factors that determine the rate of absorption of the local anesthetics tetracaine cocaine procaine and benzocaine were studied in human subjects and dogs Blood concentrations obtained by intravenous injection were compared with those obtained by infusion infiltration and topical application under various conditions Concentrations reached in the blood after intravenous injection were much higher when infusion was rapid than when it was slow Absorption from

(6) J A M A 168 873 8 7 Oct 18 1958

the mucous membranes of the pharynx and trachea gave blood concentrations comparable to those attained by intravenous injection Absorption of detectable amounts occurred from the surface of abraded skin and from raw surfaces after third-degree burns but not after first- or second degree burns

Vasoconstrictors, such as epinephrine and arterenol, do not retard absorption from the mucous membranes They are, however, effective in retarding absorption after perineural or subcutaneous injection The vasoconstrictor effect of a 10% solution of cocaine is no more effective in retarding absorption than that of the 4% strength

Local anesthetics incorporated in water-soluble creams are absorbed from the mucous membranes Absorption is poor if the drug is incorporated in an oily medium Aqueous suspensions of the crystals give detectable drug levels when applied to the mucous membranes Hyaluronidase aids absorption of injected local anesthetics but has little influence on absorption in surface application

The suffix "-caine" appended to the name of a drug usually indicates that the compound is a local anesthetic The suffix does not necessarily designate a particular chemical or pharmacologic type of drug It has been used to name compounds qualitatively similar to procaine and cocaine in pharmacologic behavior Sensitization may occur from many varieties of drugs, local anesthetics included These qualities are not peculiar to local anesthetics or to those with names ending in the suffix "-caine"

► [Certain old wives tales traditions and established concepts are thoroughly shaken by the observations reported Note, for example the failure of higher concentrations of cocaine to be more vasoconstrictive than the 4% concentration —Ed]

Histopathologic Effects of Long Exposure to Local Anesthetics on Peripheral Nerves. Philip Pizzolato and O J Renegar[7] (New Orleans) observed in animal experiments the effect of long exposure of the sciatic nerve and adjacent tissue to procaine, 1% , lidocaine, 1% , chloroprocaine, 1% , dibucaine, 0 075% , tetracaine, 0 1% piperocaine, 1 5% , hexylcaine, 1% , sodium chloride, 1% and 10% , and phenol, 1% solution

Repeated injections of the local anesthetics and 1% solution of sodium chloride in the region of the sciatic nerve of rats caused muscle damage and infiltration of neutrophils,

(7) Anesth & Analg 38 138 141 Mar Apr 1959

lymphocytes and macrophages Procaine, chloroprocaine, lidocaine and 1% solution of sodium chloride produced the least muscle damage No nerve injury was noted after administration of the anesthetic drugs When the sciatic nerve was exposed and the drugs were applied adjacent to the epineurium, muscle damage was observed with all the drugs in fairly uniform degree and was probably due to surgical trauma Histopathologic changes in nerves were noted after administration of dibucaine, hexylcaine, tetracaine and piperocaine; these changes disappeared in 48 hours

On 3-30 occasions the sciatic nerve area of rats was injected with the seven common local anesthetics, after which the area was removed and histologic slides were prepared All the drugs produced leukocytic infiltration and muscle injury, being mildest with procaine, chloroprocaine, lidocaine and 1% solution of sodium chloride In a second study, these four drugs were instilled into the sciatic region for 6 hours, but no obvious nerve injury was observed Solutions of 10% sodium chloride and 1% phenol caused extensive degeneration of the myelin sheath and axon

When the animals were permitted to live 48 100 hours after receiving local anesthetics, there remained an extensive infiltration of lymphocytes and macrophages among the muscle fibers and in the epineural connective tissue, but not among the nerve fibers With 10% solutions of phenol and sodium chloride, extreme vacuolation and eosinophilic granularity of the myelin fragmentation of the axons and diffuse enlargement of the nerve fibers were produced, frequent neutrophils and lymphocytes were observed among the nerves

Is Heat Sterilization of Local Anesthetic Drugs a Necessity? L Donald Bridenbaugh and Daniel C Moore[8] (Mason Clinic, Seattle) in a survey of the technics observed in using local anesthetic drugs found that only 33 of 101 hospitals autoclaved the solutions before use The other hospitals depended on cold sterilization the immersion of the ampule, vial or bottle in a germicidal solution which acts on the outside only Experience with 17 368 regional block procedures during 54 months showed that a technic which includes autoclaving the anesthetic in its container is mandatory The following procedure is based on the demonstration that the

(8) J A M A 168 1334 1337 Nov 8 1958

local anesthetics most commonly used can be autoclaved for 30 minutes at 255-260 F. and 18-20 lb. without significant loss of potency. This reduces the danger of bacterial contamination and simplifies preparation of regional block trays and execution of such anesthesia.

TECHNIC.—Needles, syringes and solution cups are washed with copious amounts of clear tap water and rinsed with ether. Detergents are not used. The stainless steel trays for regional block anesthesia, containing the equipment, drugs and solvents, are prepared. A sterilizer control (Diack) is placed in each tray as it is wrapped. The trays are then autoclaved at 225-260 F. at 18-22 lb. for approximately 30 minutes.

When the tray is dry it is removed from the autoclave and stored on a shelf away from all solutions, for if solutions are unsuspectedly spilled on the tray it may become contaminated. Reserve ampules of drugs for all regional block procedures are placed in test tubes which are sealed. Extra bottles of saline solution and vials of commercially prepared local anesthetic solutions too large to fit in test tubes are wrapped individually with a sterilizer control and heat sterilized. Test tubes, wrapped bottles and vials are stored in a special cabinet.

The authors do not use hospital-prepared solutions for any regional block procedure. Even commercially prepared solutions are autoclaved before use. All multiple-dose vials are resterilized after use and before the rest of the solution is injected into another patient. Ammonium sulfate solutions, oil solutions for local anesthesia and absolute alcohol can be heat sterilized.

Use of Sympathetic Blocks in Orthopedic Surgery. According to John J. Brennan[9] (William Beaumont Army Hosp., El Paso, Tex.), most patients with reflex sympathetic dystrophy first manifest only pain, others only edema or pseudo- or vasomotor disturbances. Such patients with early reflex sympathetic dystrophy with single symptoms or no objective signs are difficult to recognize. Prophylactic sympathetic blocks must be used early to successfully prevent or treat reflex sympathetic dystrophy and to thus shorten rehabilitation of such patients. Much time can be lost by waiting for a combination of symptoms or severity of a symptom to develop to warrant diagnosis of reflex sympathetic dystrophy. For this reason, the author used blocks prophylactically to treat patients with any symptoms described as manifestations of reflex sympathetic dystrophy, viz., pain, swelling, cyanosis, coldness or redness and in-

(9) J.A.M.A. 168:504-508, Oct. 4, 1958

creased heat of extremities or increased sweating of the injured part

Brennan reviewed data on 100 orthopedic patients in whom sympathetic blocks were used prophylactically The primary diagnoses included bursitis, acute or chronic, or the residuals thereof, reflex aching of the extremity, trauma of the joint with limitation of motion, postfracture limitation of joint motion, postoperative limitation of joint motion, reflex sympathetic dystrophy, swelling, posttraumatic and surgical, and swelling as a residual of vascular complications Stellate blocks were used 158 times in 77 patients In 12 patients, 20 epidural blocks were used Two received both epidural and lumbar sympathetic blocks

All had effective blocking of the sympathetic nerve Some blocks were ineffective or the effect was not maximal and these were repeated with good results For full results, some patients required repeated blocks after the original results were found to be temporary In some patients lumbar sympathetic blocks produced temporary improvement, but epidural blocks produced the cure

Ten patients failed to receive significant benefit from the sympathetic blocks as expected Analysis of these failures showed that 5 had received single blocks Of the 10, 2 received epidural blocks 5 lumbar sympathetic and 3 stellate

► [Although the hypothesis seems reasonable and the results encouraging it is always difficult to assess the effectiveness of therapy in circumstances in which control observations are limited —Ed]

Spread of Radiopaque Solutions in Epidural Space of Human Adult Corpse was investigated by Daniel C Moore, L Donald Bridenbaugh, Eugene G Van Ackeren, Francisco B Belda and Frank V Cole[1] (Mason Clinic, Seattle) to try to determine the volume of local anesthetic solution that must be injected into the epidural space to effect satisfactory analgesia and to find whether, if the dura is inadvertently punctured during placement of the needle in the epidural space, the injected solution enters the subarachnoid space via the hole or holes

Iodopyracet (Diodrast®) in 70% solution was injected into the subarachnoid or epidural space of 19 corpses and its spread was checked by anteroposterior and lateral roentgenograms 20 minutes afterward Study of these films

(1) Anesthesiology 19 377 385 May June 1958

showed that (1) the iodopyracet solution tracked out the intervertebral foramens through the entire length of the visible shadow of the radiopaque material, (2) it is seldom or never necessary to inject more than 20 cc of local anesthetic solution into the epidural space to obtain a level of anesthesia satisfactory for most surgical procedures, (3) if 20 cc of solution or less is injected into the epidural space after inadvertent puncture of the dura, little if any of the solution enters the subarachnoid space, and (4) even if 40 cc solution is injected, a segmental type of anesthesia is produced

The authors' clinical observations support the finding that 20 cc local anesthetic need not be exceeded to produce satisfactory analgesia, provided (1) the epidural space is tapped at the correct vertebral interspace, (2) the entire calculated dosage of local anesthetic solution is deposited in the epidural space, (3) the effect of gravity on fluids placed in the epidural space is allowed to exert its effect, (4) the local anesthetic solution is injected at a rate of not less than 1 cc / second and (5) the time taken in refilling the 10 cc syringe is kept to a minimum, because spread of the solution within the epidural space is improved by pressure created by the injection Selection of the appropriate interspace for entry into the epidural space is the most important single factor in assuring adequate analgesia with a segmental spinal epidural block, when volumes not exceeding 20 cc are used

Upper Arm Block Anesthesia in Children with Fractures can be performed safely, according to Mack L Clayton and Donald A Turner[2] (Denver), by the method of Accardo and Adriani

METHOD —The proximal humerus is used as a backstop instead of the 1st rib or pleural dome The terminal portion of the axillary artery serves as a constant landmark (Fig 159)

With the arm at 95 degree abduction from the body and in neutral rotation the artery is palpated at the level of the insertion of the pectoralis major and a skin wheal is raised directly over the artery The needle bevel must be down and the solution coming from the end of a 1 in 25 gauge needle as it enters the skin The needle is directed above the artery, and 2 4 cc of the drug is deposited above, and above and beyond the artery Abduction is maintained the needle withdrawn to the subcutaneous area and the arm is put into considerable external rotation at the shoulder The needle is reintroduced below the artery and 1-2 cc of the drug deposited Then the needle is advanced virtually to the humerus so it is below and behind the

(2) J A M A 169 327 329 Jan 24 1959

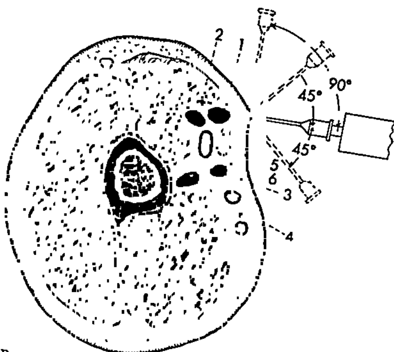


Fig. 159.—Brachial plexus block by axillary route Cross section is at junction of axilla and arm (through line *1*, Fig 160). *1*, median nerve, *2*, musculocutaneous nerve; *3*, ulnar nerve, *4*, radial nerve; *5*, brachial artery; and *6*, vena comitans (Courtesy of Clayton, M. L., and Turner, D. A J A M A 169 327 329, Jan 24, 1959)

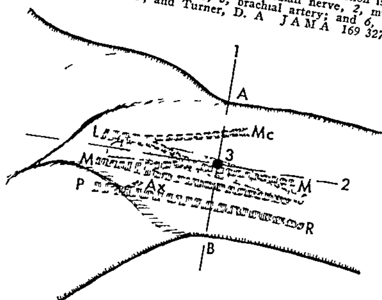


Fig 160—Axilla showing landmarks for brachial plexus block by axillary route Line *1* is drawn through points of insertion *A*, of pectoralis major and, *B*, of teres major muscles into humerus Line *2* bisects line *AB* and falls directly over brachial artery Wheal is raised at point *3* *L* is lateral cord of plexus, *M* medial and *P* posterior, *Mc* is musculocutaneous nerve and *R* radial nerve. Note that axillary nerve, *Ax*, has been given off before site of block (Courtesy of Clayton, M L, and Turner, D A J A M A 169 327 329, Jan 24, 1959)

artery and 2-4 cc of the drug is deposited Aspiration is performed before each injection The needle and humerus should be at a 90 degree angle If paresthesia is elicited injection of 0 5 1 cc of the drug is done promptly at this position Paresthesias are not deliberately sought The median and musculocutaneous nerves are much easier to block with the arm in neutral rotation Likewise the ulnar and radial nerves are much easier to block with the arm in considerable external rotation (Fig 160)

This method was used in 80 children, 72 were aged 10 or less In only 1 was the block ineffective In most patients, the authors used 1 5% concentration of lidocaine (Xylocaine®) hydrochloride with epinephrine hydrochloride, 1 100,000 Only one minimal reaction occurred twitching at the corners of the patient's mouth

If 1½-4 hours of anesthesia are desired, 1% solution tetracaine (Pontocaine®) hydrochloride is added to the lidocaine so that the final mixture has 1 5 mg tetracaine/cc solution This gives quick onset from the lidocaine and duration from the epinephrine and tetracaine

This block is especially useful in treatment of recent fractures in children

---

SPINAL ANESTHESIA

Electromyogram in Evaluation of Neurologic Complications of Spinal Anesthesia was studied by Albert A Marinacci (Univ of Southern California) and Cyril B Courville[3] (College of Med Evangelists) Differentiation of complications caused by spinal anesthesia from other conditions is based on distribution of the denervation, i e electromyographic changes, and on the time in which the denervation activity is first detected electromyographically

The difference between lesions of the nerve plexuses or the individual peripheral nerves and the complications of spinal anesthesia is that in the complications denervation activity will be found in the paraspinal muscles and those of the lower extremities whereas in disorders of the plexuses and of the peripheral nerves the electromyographic changes are confined to the respective muscle groups If the lesion involving the plexus or the peripheral nerves pre existed the spinal anesthesia for 3 weeks the denervation activity will

(3) J A M A 168 1337 1345 Nov 8 1958

Neurologic screening examinations revealed that 96 of the 1,077 patients had suggestive neurologic complaints and signs of neurologic changes Only 9 of these showed significant neurologic deviations Analysis showed that 6 of the 9 had findings that were probably related to saddle block anesthesia These consisted of absent or markedly decreased reflexes in 3 patients, sensory changes in the legs in 2 and headaches and dizziness in 1 In the other 3 patients, there was some question as to the relation of their symptomatology to saddle block anesthesia Two of them had herniated disks, 1 in the thoracic region and 1 in the lumbar region, and 1 had severe headaches and dizziness for 5 years before and since first receiving saddle-block anesthesia In the last-mentioned patient the neurologists were unable to find any neurologic changes and felt that the headaches and dizziness were not caused by the anesthesia but may have been exaggerated by it

Therefore, of the 1,077 patients examined, 9, or less than 1%, showed even suggestive changes on neurologic examination that might be related to the saddle-block anesthesia and in only 0 5% were the changes probably related to the anesthesia This is an unusually low rate for late anesthetic complications of any kind

The authors' experience indicates that paralysis or severe complications from saddle block anesthesia are rare This method of anesthesia given for delivery proved clinically effective and safe, with high degree of patient and physician acceptance Until better anesthesia is available or until there is 24-hour coverage in the birth room by trained anesthetists saddle block anesthesia is safer than inhalation anesthesia and more satisfactory for patient and doctor than local anesthesia

► [The conclusions of the authors might better be qualified by limiting them to the circumstances in which the authors practice The evidence presented does not substantiate the statement that saddle block anesthesia is safer than inhalation anesthesia or more satisfactory than local anesthesia —Ed]

MISCELLANEOUS

Iatrogenic Disease and Anesthesia is discussed by John W Dundee[6] (*Queen's Univ*, *Belfast*) Various drugs have been used which influence the response of patients to anesthesia This side action usually cannot be predicted by pharmacologists In all instances reported, the drug used engendered in patients an increase in toxicity of one or the other of the effects of general anesthetics

Therapeutic agents whose main effect is to decrease vascular tone, such as the ganglion-blocking drugs or chlorpromazine, if given before anesthesia increase the hypotensive action of narcotics, and severe and even fatal collapse may follow what are considered normal doses of anesthetic drugs This applies particularly to intravenous barbiturate anesthesia in which it is difficult, even in normal subjects, to predict the degree of hypotension that will follow injection and to adjust the dose so as to minimize this action Care must also be taken in anesthetizing patients who are receiving other hypotensive agents, such as the rauwolfia or veratrum alkaloids or mecamylamine

Clinical and experimental evidence shows that the phenothiazine derivatives prolong the narcotic action of anesthetics This seems also to apply to the nonphenothiazine preparations which are used for control of tremor in parkinsonism, and it may possibly be a side effect of all the tranquilizers

Dangerous respiratory depression can result from the combination of analgesic drugs and intravenous barbiturates A similar result can occur when cyclopropane is administered to patients who have had deep x ray therapy to the head and neck

Induced adrenocortical insufficiency, after prolonged use of cortisone, its analogues and corticotropin, makes patients sensitive to the stress of surgery and anesthesia Prolonged severe hypotension, respiratory depression and delayed recovery may follow surgical operations in such patients These ill effects respond rapidly to intravenous cortisol, but

(6) Brit M J 1 1433 1438 June 21, 1958

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(6) Brit M J 1 1433 1438 June 21 1958

prevention by increased preoperative dosage of cortisone and corticotropin is preferable Steroid-induced primary pituitary failure may persist several months after stoppage of the drugs Pitocin® is incompatible with light cyclopropane anesthesia Citrate intoxication should be considered in differential diagnosis of cardiovascular collapse after massive transfusion of stored blood

► [An interesting outline of the problems anesthetists can manufacture while attempting to solve problems How far can we go in the practice of polypharmacy?—Ed]

Allergy and Anesthesia Sheppard Siegal and Milton H Adelman[7] (New York) note that the asthmatic patient may present significant problems to the anesthesiologist because of impairment of pulmonary ventilation and irritability of the bronchial tree Abnormality of the ventilatory mechanism may be readily demonstrated by a reduction in total or timed vital capacity There is almost invariably a diminution of maximum breathing capacity Pulmonary ventilation is uneven, and there may be impairment of pulmonary mixing A diminished ventilatory response to CO_2 and, in some instances, decreased oxygen saturation of the blood may occur

Proper preanesthetic preparation requires maximum control of the asthma avoidance of anxiety and use of sedation, including in special instances the cautious use of tribromethanol ethanol in amylene hydrate (Avertin®) Narcotics should be avoided and atropine-like agents used with care

Ether is the inhalation anesthetic agent of choice because of its wide range of effectiveness and bronchodilator action Cyclopropane should be used only with great caution Low spinal anesthesia may be safely used with precautions against allergy to the anesthetic Intravenous thiobarbiturates are contraindicated

Succinylcholine is the preferred muscle relaxant in bronchial asthma It does not release histamine and will not aggravate the asthma The asthmatic episode occurring during anesthesia may be managed by the induction of deep ether anesthesia or by nebulization or injection of Isuprel® Bronchoscopy may be indicated postoperatively for aspiration of excessive tracheobronchial secretions or for atelectasis

Allergy to local anesthetics is uncommon, and anaphylactic shock and death are rare Reactions may occur after in

(7) New York J Med 58 2089 2093 June 15 1958

jection or topical application to membranes Pontocaine® appears less safe than other agents Skin tests are usually negative Preliminary trial doses may provide a further safeguard Local allergic edema due to procaine may be diagnosed by a positive 24-hour skin test Patch tests are diagnostic in allergic contact dermatitis due to local anesthetics

► [The problems of the patient with asthma and the management of anesthesia for such patients are well outlined However the authors overlook the fact that numerous factors influence the choice of anesthesia It may be that in certain circumstances cyclopropane is a better choice for the patient with asthma and that in another circumstance the thiobarbiturates may not be contraindicated —I d]

Management of Diabetes during Surgery According to Robert C Hardin, Arthur Sanders and William K Hamilton[8] (State Univ of Iowa), the chief hazards to which the diabetic is exposed during surgery are hypoglycemia acidosis and severe glycosuria, with water and electrolyte loss

In a patient with controlled diabetes the taking of food is suspended at midnight before the day of operation Next morning the patient receives the type and dose of insulin he normally requires at the usual time Subsequent doses are given according to the same plan For each meal he is unable to take, he ordinarily receives 50 Gm dextrose intravenously, usually as a 5% solution in water The dextrose is given at a rate of about 20 Gm /hour and is started at the regular mealtime The patient may be taken to the operating room while the fluid is being administered, or if operation is scheduled later in the day, he may receive two "meals" before going to surgery Sometimes the noon replacement is started during surgery This regimen of substituting dextrose for meals and giving the usual insulin dose continues postoperatively until the patient is able to take a liquid diet The patient who is controlled with diet alone needs no replacement of meals until the second has been missed This and subsequent ones which are omitted should be replaced

In a patient with uncontrolled diabetes operation may proceed when acetonuria has fallen below 2+ and the CO_2 content of the serum is about 75% of normal If acidosis is not present and the insulin requirement of the patient is unknown, 5-10 units of regular insulin may be given every 4 6 hours The authors prefer to give dextrose intravenously to all such patients during surgery

(8) J Iowa M Soc 48 179 183 April 1958

There is no evidence that any drug commonly used to produce anesthesia has any inherent superiority or provides increased safety for the diabetic. To minimize the need for interruption of normal eating, premedication, anesthesia and postoperative medication should be of the types and amounts which produce the least depression, nausea and vomiting. Inflation of the stomach by positive airway pressure should be avoided.

A diabetic in acidosis requires only small amounts of depressant drugs for premedication, anesthesia and postoperative pain relief. Since increased respiration is an important means of compensation for metabolic acidosis, equipment which permits rebreathing or interferes with respiratory exchange by adding resistance must be avoided.

Mortality among diabetic surgical patients has been no larger than that among all other surgical patients at the authors' hospitals.

Choice of Anesthesia for Patients with Liver Disease. John P. Bunker[9] (Harvard Med. School) reviewed the recent clinical and laboratory studies of the effects of ether, cyclopropane and spinal anesthesia on the normal and abnormal liver in man. Surprisingly little difference was found between the effects of the commonly used anesthetic agents and technics on the liver, as judged by liver function tests and by clinical results. This conclusion disagrees with opinions of previous years that were based on animal studies or on scanty and uncontrolled studies in human subjects. By contrast, the operative procedure and the degree of preoperative liver damage have pronounced effects on postoperative disturbances in liver function tests and on the clinical result.

Other considerations of great importance, but less easy to evaluate in terms of clinical results, are the pre- and postoperative care Progressive improvement in clinical results is believed to be largely due to increasing attention given to preparation for surgery· replacement of blood volume and restoration of hemoglobin and albumin levels to as near normal as possible; building up of carbohydrate stores; and adequate rest. Of equal importance are adequate caloric intake postoperatively and attention to oxygenation in the postoperative period as well as during the operation

(9) Am J Gastroenterol 29 604 611, June, 1958

The patient with actively bleeding esophageal varices who is about to have emergency transthoracic ligation of varices presents a difficult anesthetic problem and deserves special consideration Bunker intubates such patients awake, using topical anesthesia to the larynx to minimize the danger of hematemesis and aspiration After intubation, cyclopropane is used, which is better tolerated than other potent general anesthetics in presence of massive blood loss

The value of fresh-blood transfusion should be emphasized The disturbed coagulation factors as demonstrated in many of these patients undergo further deterioration with administration of routinely stored bank blood Use of a unit of fresh blood alternated with each unit of stored blood has effectively prevented further progression of clotting defects Clinically, routine use of fresh blood transfusions during shunt surgery since 1950 has been associated with a marked fall in the incidence of uncontrollable bleeding during surgery

It is suggested that the choice of anesthetic and technic should be based on considerations other than presence or absence of liver disease

► [Bunker seems to have successfully debunked some well established concepts —Ed]

Liver Glycogen Alterations in Anesthesia and Surgery were studied by H Annamunthodo, V J Keating and S J Patrick[1] (Univ College of West Indies) on patients undergoing partial gastrectomy

Patients were given 22 mg omnopon and 0 4 mg scopolamine 1 hour before operation Subsequent anesthesia was carried out by three different methods A sleep dose of thiopentone and nitrous oxide oxygen was followed by intubation with succinylcholine and maintenance with nitrous oxide oxygen and sufficient curare to allow controlled respiration In 4 patients anesthesia was similarly induced, surgical incision was made under succinylcholine and nitrous oxide oxygen and, after the first biopsy specimens were taken, the operation was continued under nitrous oxide-oxygen and ether with spontaneous respiration Three patients were given a high spinal block, with heavy Nupercaine® and nitrous oxide oxygen cover

Variable, but usually large rises in the concentration of

(1) Anaesthes a 13 429-433 October 1958

blood sugar occurred when nitrous oxide oxygen-relaxant or ether was used as anesthetic during surgery, but only small increases occurred when spinal block was used The initial values for liver glycogen were highly variable There was a fall in the concentration of liver glycogen in each patient regardless of the type of anesthetic used There appears to be little correlation between the fall in liver glycogen and the rise in blood sugar which occurred, except where a spinal

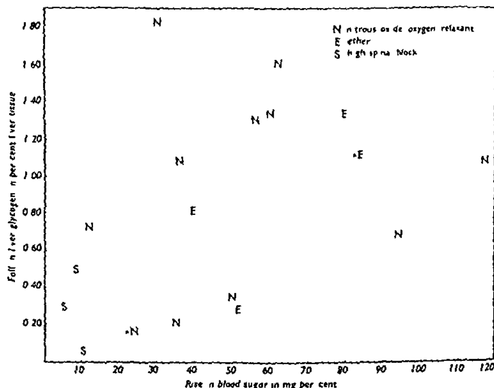


Fig 161 —Relation between rise in blood sugar and fall in liver glycogen during surgery *with three methods of anesthesia* (Courtesy of Annamunthodo H et al Anaesthesia 13 429 433 October 1958)

analgesic was administered (Fig 161) In these cases the fall in liver glycogen and rise in blood sugar were small The changes in muscle glycogen were small and of doubtful significance

It has long been known that the chief source of blood sugar in a fasting subject is liver glycogen, so a correlation between rise in blood sugar and fall in liver glycogen might have been expected That little correlation was found is probably attributable to the variations in initial liver glycogen concentration and in rates of peripheral utilization of glucose

It is pertinent to ask whether a rise in blood sugar at the expense of liver glycogen is of benefit to the patient during operation If it is considered detrimental, spinal block would appear to be the anesthesia of choice in abdominal surgery If it is considered advantageous, nitrous oxide oxygen relaxant would be the logical choice

Treatment of Acute Respiratory Infection in Infants H I Armstrong Nisbet and Frank Wilson[2] (Liverpool)

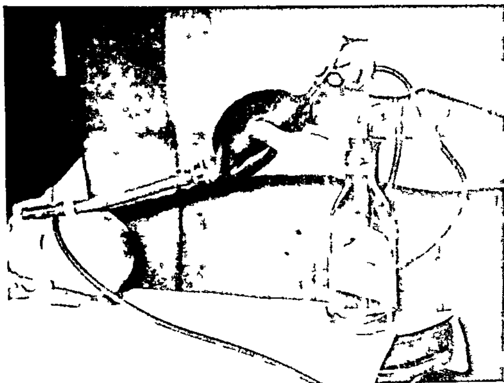


Fig 162 —Rees s modification of Ayre s T piece circuit in use with safety device Rubber bag is connected to T piece circuit Y shaped glass connection is inserted into tail of bag Second limb of connection is attached to glass tubing in transfusion bottle half full of water Glass tubing dips well below surface of water Inspiration is effected by closing third limb of Y connection with one thumb while other thumb compresses bag Pressure in circuit is then limited by escape of gases through limb of Y connection attached to transfusion bottle Expiration is effected by releasing pressure on bag and removing thumb from limb of Y connection (Courtesy of Nisbet H I A and Wilson F Brit J Anaesth 30 419-434 September 1958)

observe that atmosphere, posture humidity and temperature should be readily controllable and respiratory movements easily observed Such conditions may best be achieved where infants are nursed naked in incubators

Restoration of the airway by intubation and suction is essential in many cases In some instances intubation has had to be repeated many times, and in others it has been neces

(2) Brit J Anaesth 30 419-434 September 1958

sary to leave an endotracheal tube in position for prolonged periods Endotracheal intubation is indicated when cough is ineffective or when the child is too ill to maintain adequate ventilation by its unaided efforts Controlled respiration is beneficial when severe exhaustion makes ventilation inadequate

In older and more active children muscular relaxation should be produced if intubation is to be accomplished with minimal trauma Intravenous injection of 5-10 mg suxamethonium will cause complete paralysis

TECHNIC—After intubation a fine no 3 Jacques rubber catheter, from which the end has been removed, is introduced into the trachea Suction is applied, and any secretion present is removed The lungs are inflated with oxygen the tube being connected to the T piece circuit (Fig. 162) If the lungs fail to expand when gentle pressure is applied to the bag, suction should be repeated until inflation is possible

With return of normal color and active cough the tube should be removed If secretions continue to accumulate in the absence of an effective cough, repeated intubation and suction may be required When respiration is inadequate to maintain oxygenation, the endotracheal tube must be retained and controlled respiration instituted Because of copious secretions, pharyngeal suction should be performed hourly, preferably before feeding Humidification of the atmosphere is essential in all patients If controlled respiration is required, 100% humidity is needed For the best use of respiratory efforts, inhalation of material from the nose, mouth and pharynx should be avoided, the position should encourage drainage of secretions from affected segments and should allow the infant to ventilate its lungs with minimal effort General considerations tend to show that the position of choice may be head up For sedation intramuscular pethidine, 0 2 mg /lb, is suggested When the lungs fail to reexpand by intubation and suction followed by positive pressure, bronchoscopy may be necessary Administration of streptokinase and streptodornase should be deferred until systemic antibiotics have had time to be effective

► [The authors clearly indicate that in order to achieve better results constant and sensible attention is necessary —Ed]

Acid-Base Status of Human Infants in Relation to Birth Asphyxia and Onset of Respiration was studied by L S James, I M Weisbrot, C E Prince, D A Holaday and

V. Apgar[3] (New York) Analyses were made of blood samples obtained from the artery and vein in a clamped segment of the umbilical cord at the moment of delivery in 101 infants There was a wide range in oxygen levels in umbilical artery and vein blood and in arteriovenous difference All showed some asphyxia with a low oxygen saturation and a high CO_2 tension Of 63 umbilical artery samples, 26 had an oxygen saturation below 10% and 7 had no measurable oxygen Of these severely anoxic infants, 14 were not depressed and cried spontaneously within seconds of delivery Four were

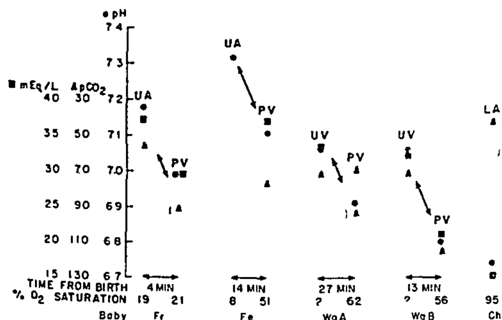


Fig 163—Changes in pH Pco2 and buffer base in 5 depressed newborns *UA* umbilical artery *UV*, umbilical vein, *PV*, portal vein *LA* left atrium Same umbilical vein sample was used for comparison in twins (Wa A and Wa B) Values for Ch represent pure metabolic acidosis remaining after 25 minutes of resuscitation Oxygen saturation in left atrium was 99% (Courtesy of James L S *et al* J Pediat 52 379 394 April, 1958)

in the intermediate group and 8 were in the depressed group The highest umbilical artery oxygen saturation recorded was 51% Umbilical artery pH ranged from 7 0 to 7 35, with mean of 7 26 for the vigorous infants and 7 14 for the depressed infants For the vigorous infants, Pco_2 was 39 98 mm Hg, with a mean of 55 and 74 for the depressed infants, indicating respiratory acidosis

Depression of the buffer base below normal of 42 mEq /L for pregnant women (normal for adult males 47-50) revealed superimposed metabolic acidosis in several instances Com-

(3) J Pediat 52 379 394 April 1958

on the infant's chart as to when oxygen therapy is begun and terminated.

► [Although the concern over the development of retrolental fibroplasia is well founded, it is unfortunate that the precautions taken to prevent high oxygen atmospheres are so rigid that many infants in need of high concentrations of oxygen are denied this lifesaving atmosphere—Ed.]

Compatibility of Synthetic Oxytocin (Syntocinon) with Anesthesia in Dogs was studied by Stanley A. Feldman, Dean M. Forgaard and Lucien E. Morris[5] (Univ. of Washington). Establishment of the structural formula of the oxytocic principle of the posterior pituitary and its subsequent synthesis has allowed a chemically pure oxytocic, syntocinon, to be introduced in obstetric practice. This has reopened the question of the compatibility of this type of drug with anesthetic agents. Cardiac collapse and death have been reported after administration of posterior pituitary extracts to anesthetized patients. Parsloe and co-workers studied the effects of various pituitary fractions on dogs during administration of several anesthetics. Their findings were correlated with subsequent clinical observations. The studies confirmed the fact that Pitocin® had little effect on the cardiovascular system. Syntocinon is credited with pharmacologic effects similar to those of Pitocin®.

The authors studied the effects of syntocinon on dogs during cyclopropane, trichloroethylene and barbiturate anesthesia. During cyclopropane anesthesia, syntocinon caused decrease in blood pressure in 8 of 15 experiments, had no effect in 5 and caused an increase twice. No ECG abnormalities were detected. During trichloroethylene anesthesia, syntocinon caused a rise in blood pressure in the 3 experiments performed. Exaggerated sinus arrhythmia was observed once. During barbiturate anesthesia an increase in blood pressure occurred twice. No change was recorded in the third dog. Syntocinon appeared to afford some protection against epinephrine-induced arrhythmias under cyclopropane and trichloroethylene anesthesia.

Syntocinon administration appears to be compatible with cyclopropane, trichloroethylene and barbiturate anesthesia. It appears to be free from pressor factor and to depress, to some extent, the myocardial irritability produced by cyclopropane and trichloroethylene.

(5) Anesthesiology 19 787-791, Nov.-Dec., 1958.

Mechanisms of Transmission in Central Nervous System were studied by W D. M. Paton[6] Substances considered as possible transmitters are: acetylcholine, noradrenaline, serotonin, substance P, and gamma-aminobutyric acid Fedberg and Vogt, studying the regional distribution of choline acetylase, found alternation in neurons of the central nervous system, such that if one neuron could synthesize acetylcholine, then the next neuron was unable to and presumably was not cholinergic. Three of the alterations to which Feldberg and Vogt drew particular attention are shown in Figure 164. Of these, the first, i e , the sequence down the py-

1. CEREBRAL CORTEX	→ PYRAMIDAL TRACT ARISING FROM BETZ CELLS	→ MOTONEURONES AND MOTOR NERVE AXONES
ChA activity +	−	+
ACh content +	−	+
ACh release +		+

2 SENSORY NERVES AND POSTERIOR COLUMNS	→ POSTERIOR HORNS N GRACILIS N CUNEATUS N VESTIBULARIS	→ THALAMUS AND INTERNAL CAPSULE
ChA activity −	+	−
ACh content −	+	−

3. RETINA	→ OPTIC NERVE	→ LATERAL GENICULATE SUPERIOR COLLICULUS
ChA activity +	−	+
ACh content	−	+

Fig 164 —Possible alterations of cholinergic and noncholinergic neurons For each pathway, nature of evidence is indicated i e presence (+) or lack (—) of cholineacetylase activity, acetylcholine content or acetylcholine release during activity (Courtesy of Paton, W D M Anaesthesia 14 3 27, January, 1959)

ramidal pathway, is now suspect because of evidence that the pyramidal tract does not directly innervate motoneurons, but that another neuron is intercalated before the anterior horn cell Sequence on the sensory side, however, was fully substantiated recently

Although noradrenaline, 5-hydroxytryptamine and substance P are rather different pharmacologically, they may provisionally be grouped together because their central distributions are alike Substance P occurs particularly in the brain and the alimentary tract and is able to contract isolated smooth muscle The main concentration of the three substances seems to be around the 3d and 4th ventricles

(6) Anaesthesia 14 3 27, January, 1959

and aqueduct, perhaps in particular relation to the structure known as the reticular formation Substance P, in addition, occurs in the sensory pathway Enzymes exist in the brain, too, that can form and destroy sympathins and 5-hydroxytryptamine

Certain brain extracts have been found to inhibit the discharge of a sensory receptor The inhibitory factor has been shown to consist, in part at least, of gamma aminobutyric acid, an aminoacid molecule

It is believed that acetylcholine is involved in certain central synapses, that noradrenaline, 5-hydroxytryptamine and substance P may well be concerned, but possibly only as modulators, and that gamma-aminobutyric acid has a still obscure role of considerable interest on the inhibitory side With the solitary exception of the Renshaw cell, it can not be said that a definite synapse is operated by a definite transmitter

Translaryngeal Anesthesia Review is presented by Martin Irwin Gold and Donald Robert Buechel[7] (US Naval Hosp, Chelsea, Mass) Some anesthesiologists believe that translaryngeal anesthesia for routine orotracheal intubation is superior to the transglottic route The sudden cough after injection of the anesthetic solution sprays it from the carina to the undersurface of the vocal cords, even the hypopharynx is anesthetized This allows for more direct and profound topical anesthesia of the larynx and trachea Translaryngeal anesthesia also facilitates tracheal intubation because the cords are relaxed and a tube may be easily inserted without hazard of spasm After the tube is inserted, no "bucking" or breath holding occurs and if anesthesia is complete, hypoxia may be avoided Incidence of reflex cardiac arrhythmias during intubation is probably reduced Another indication for translaryngeal anesthesia is for bronchoscopy This procedure requires good carinal and bronchial anesthesia, an objective that cannot be accomplished by nebulizers as easily or rapidly as by direct intralaryngeal deposition

Translaryngeal anesthesia has been described for endobronchial intubation Laryngotracheal anesthesia is first obtained and after 3 5 minutes a second puncture is made with the patient sitting and leaning to the side of the bronchus to be intubated Blind nasotracheal intubation, with the pa-

(7) Anesthesiol 20 181 185 Mar Apr 1959

tient awake or asleep, represents another indication for translaryngeal anesthesia. The procedure is facilitated, time is saved and less trauma is produced. Less general anesthesia is required for intubation because topical anesthesia renders the intrinsic and extrinsic laryngeal muscles insensitive to reflex stimulation by the tube. The nasal passages and the pharynx, however, must be anesthetized from above

Contraindications include an enlarged thyroid gland or tumor overriding the thyroid or cricoid cartilage and active disease of the tracheobronchial tract, such as infection or carcinoma

Among over 17,500 translaryngeal anesthesias reported in the collective literature, there were no deaths

► [Although serious complications might be expected, the number reported are few —Ed]

Radiation Safety for the Anesthesiologist is evaluated by William H. L. Dornette (Memphis) and Theodore Ott (Los Angeles).[8] Because the anesthesiologist is administering more and more to patients during diagnostic x-ray procedures, he needs to have a rational understanding of the possible hazards and optimal safeguards with respect to himself and to the patient.

The roentgen rays that emanate from the tube are directed by a cone through the patient and onto the screen of the fluoroscope or film cassette The most hazardous area is in front of the cone and the anesthesiologist should keep out of this area. About 10-30% of the rays that strike the patient, screen and table scatter in all directions and are dissipated inversely as the square of the distance The closer the anesthesiologist stands to the patient, the higher will be the concentration of this scatter Even if the anesthesiologist avoids the direct beam, he can be exposed to this scattered radiation This hazard can be minimized by wearing a lead apron and standing as far from the patient as possible or by leaving the room. Lead gloves should be worn if the anesthesiologist expects to have his hands in or near the direct rays

Whether there is a "safe" dosage and what that dosage is, is still open to debate. Current radiation safety dictates that the worker should not be exposed to over 0 3 r per week Recommended safe dosage has been lowered three times in the past 10 years and its further reduction is being discussed

(8) Anesth & Analg 37 167 171, July Aug, 1958

The most practical method for determining individual radiation dosage is the film badge

The dosage of radiation expected to be associated with average diagnostic x-ray procedures is shown in the table Direct dose is calculated *from expected tube output*, with the scatter measured from film badges placed outside the anesthetist s apron at table height under nearly ideal circumstances Optimal safe conditions do not always prevail hence it is desirable for the anesthesiologist to be aware of the need for radiation safety The anesthesiologist has little

Direct and Scatter Radiation during Diagnostic X-ray Procedure

Procedure	Calculated * direct dose *roentgens*	Measured† scatter dose in *roentgens*
Cardiac catheterization	28	57 mr
Biplane angiography	6 *to* 8	7 8 mr
Pneumoencephalography	0 5 per exposure	0 28 mr
Carotid arteriogram	0 5 per exposure	
Anteroposterior and *lateral views of* lumbar portion of spinal column (radiologic control of needle placement for nerve block)	7 6	

*Calculated from x ray tube output
†Measured with film badge placed at table height 1 ft from patient

control over exposure of the patient, but he is responsible for rendering the patient under general anesthesia immobile when the x ray is taken The need for a second series of x rays because the patient moved prolongs anesthesia time and doubles the radiation exposure of the patient and anesthesiologist Any one of various anesthesia technics that produce apnea may be used just before exposure of the film

With advent of x ray control of needle placement for nerve blocks the anesthesiologist becomes directly responsible for the patient s exposure to potentially harmful radiations This procedure should not be performed routinely, especially because the patient may have had many x ray procedures

Postanesthetic Nausea, Retching and Vomiting: Evaluation of Cyclizine (Marezine®) Suppositories for Treatment John J Bonica, William Crepps, Benjamin Monk and Blair

Bennett[9] studied incidence of postanesthetic nausea, retching and vomiting in 2,827 patients who received various forms of general and regional anesthesia for diversified operations. Retching and vomiting occurred in 627 (22.3%) and 156 (5.4%) had only nausea; incidence of emetic symptoms was thus 27.7%.

Results of a controlled study indicated that cyclizine produced complete or partial relief in about 93% of the patients, as compared with 60% who obtained similar relief from placebo suppository. This beneficial effect was accomplished with minimal incidence of side effects.

Ether as a primary anesthetic agent was followed by the highest incidence of emetic symptoms (64.2% of 173 patients), with cyclopropane next in order (55.6% of 232 patients). Thiopental alone produced the lowest rate of emetic symptoms (8.3% of 36 patients), with nitrous oxide thiopental next in order (14.5% of 878 patients). Addition of meperidine to the nitrous oxide thiopental combination augmented incidence of emetic symptoms threefold (43.8% of 242 patients).

Patients who received regional anesthesia showed significantly lower incidence of emetic symptoms (21.7% of 1,180 patients). Local infiltration or field block was followed by the lowest rate (6.5% of 31 patients), whereas spinal technics (subarachnoid, spinal epidural and caudal block) were associated with the highest incidence (21.1-28.5% of 1,000 patients). Use of general anesthesia, made necessary by failure of a regional technic to provide adequate conditions, increased the rate of emetic symptoms to 59.3% (51 of 86 patients).

Site, type and duration of operations were important in influencing the rate of postanesthetic emetic symptoms. Upper intra-abdominal procedures involving the stomach, duodenum and gallbladder in 176 patients were associated with nausea, retching and vomiting in about 127 (72%), whereas perineal procedures and operations involving the extremities in 178 patients were followed by the lowest incidence (15.1%). The longer the time required to complete the operation, the greater the incidence of emetic symptoms. Inextricably related to this factor are type and duration of anesthesia. Operations requiring long-lasting deep anesthesia

(9) Anesthesiology 19:532-540, July-Aug., 1958.

are followed by higher incidence of emetic symptoms than shorter procedures or those requiring lighter planes of anesthesia.

This study clearly shows the effectiveness of cyclazine in preventing or relieving postanesthetic nausea, retching and vomiting and that rectal administration is as efficient as intramuscular injection. It is suggested that this route be used more often because it avoids the unpleasantness of an injection.

Decision as to whether attempt should be made to prevent emetic symptoms or whether treatment should be withheld until symptoms develop depends on the individual situation and requires consideration of: risk of side effects from use of the drug; increased amount of nursing care; psychologic *make-up of the patient; and expenses entailed in using the* medication routinely.

Use of Cardiac Monitoring Systems in Anesthesia was studied by David A. Davis and Kenneth Sugioka[1] (North Carolina Mem'l Hosp, Chapel Hill). *Basically, all* cardiac

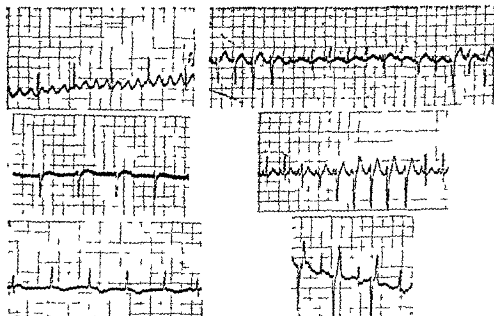


Fig 165—Examples of cardiac arrhythmias not detectable by monitoring devices that depend on R wave (Courtesy of Davis, D A, and Sugioka, K Am Surgeon 24 647 650, September 1958)

monitoring systems are electronic amplifiers They receive a signal, amplify this signal and convert it into a sound, flashing light, deflection of a cathode-ray beam or into some-

(1) Am Surgeon 24 647 650 September, 1958

thing that can be seen, heard or even felt by the anesthetist Most of these amplifiers use as a signal source the large R wave of the electric activity of the heart

Hypodermic needles inserted just beneath the skin and taped firmly in place are much more satisfactory than surface electrodes Even then passive movement of the patient

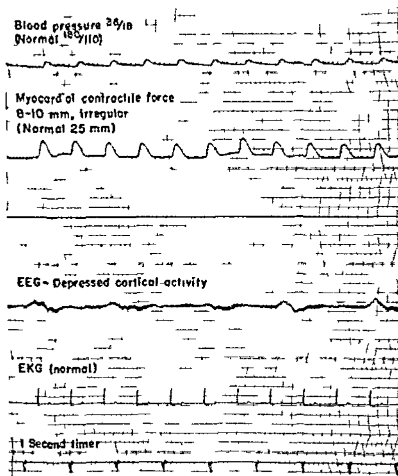


Fig 166 —Normal ECG in presence of severe and irreversible circulatory depression (Courtesy of Davis D A and Sugioka K Am Surgeon 24 647 650 September 1958)

may result in a signal that is more distracting than valuable Imperceptible muscular activity, such as is encountered in hypothermia, may produce an artifact that is disturbing The ECG, or better yet, the EEG may be invaluable in signaling presence of this undesirable muscular activity The optimal location for the needle electrode is over the precordium, with the indifferent electrode near the right arm for convenience

Static is a common source of annoyance in use of cardiac

monitoring systems Stray signals from lights, elevators or any electric equipment that is poorly shielded may produce signals that render monitoring equipment useless Many of the changes in electric activity of the heart cannot be detected by monitoring systems that demonstrate only the R wave Figure 165 illustrates some of these arrhythmias or cardiac abnormalities Some are instantly detectable by cursory examination of the ECG, but how many surgeons or persons administering anesthetics are sufficiently versed in ECG to detect them?

The electric voltage of the heart is only one of the criteria for diagnosis of the presence or absence of severe cardiac disease It is known generally that electric activity of almost normal values can occur in the presence of ineffective circulation Figure 166 shows relatively normal ECG in presence of almost no perceptible heart action Many cardiac monitors would interpret this picture as normal To rely solely on such instruments is to court disaster

► [The anesthetist should be aware of the limitations of monitoring devices and avoid placing unwarranted reliance on them —Ed]

Comparative Effects of Anesthetic Agents on Cardiac Irritability during Hypothermia were studied by John E Steinhaus Karl L Siebecker and James R Kimmey[2] (University of Wisconsin) The effect of four anesthetic agents or combinations on incidence of ventricular fibrillation in dogs during hypothermia was investigated Arrhythmias were initiated with application of mechanical stimulation in the form of cardiac massage

TABLE 1—RESULTS OF EXPERIMENT AT 27 C (80 6 F) PLUS OR MINUS 1 DEGREE WITH NO VENTRICULAR FIBRILLATION OCCURRING

		Control (100% Oxygen)			Hypercapnia (10% Carbon Dioxide)			Hypoxia (15% Oxygen)		
Agent	Dogs No	pH	pCO	Oxygen Vol %	pH	pCO₂	Oxygen Vol %	pH	pCO₂	Oxygen Vol %
Cyclopropane	10	7 55	21 7	19 5	7 15	73 5	19 7	31	21 2	13 1
Diethyl ether	10	7 45	18 8	22 1	7 04	6 8	21 5	3	20 4	19 4
Thiopental and nitrous oxide	10	7 50	28 7	21 8	7 2	54 2	22 7	7 3	25	15 9
Thiopental lidocaine and nitrous oxide	10	57	21 7	23 2	7 19	0 5	24 1	7 55	32 2	19 4

Ventricular fibrillation did not occur in any of the experiments at 27 C (Table 1) The blood values taken after the

(2) J A M A 169 8 11 Jan 3 1959

control period indicate adequate oxygenation and mild hyperventilation The addition of 10% CO_2 is reflected in the low pH and high P_{CO_2} values In a similar manner, ventilation with 15% oxygen is reflected in the results of the blood analysis After cardiac massage, there were many periods of markedly abnormal ECG and periods of depressed cardiovascular function Improvement in these conditions occurred with removal of the stimuli and ventilation with oxygen

The second series of experiments at 20 C resulted in the frequent occurrence of ventricular fibrillation (Table 2). In addition to the four anesthetization technics used in the

TABLE 2—Results of Experiments at 20 C (68 F) with Ventricular Fibrillation and Cardiac Failure

Agent	Dogs No	Temperature Degrees Centigrade	Ventricular Fibrillation: Spontaneous	Ventricular Fibrillation: Mechanical	Failures No	Oxygen Vol %	pH	pCO
Cyclopropane	10	23	8	2	0	22.0	7.55	17.0
Diethyl ether	10	21	4	2	0	16.0	7.49	12.4
Thiopental and nitrous oxide	10	21	3	2	0	19.0	7.64	19.7
Thiopental lidocaine and nitrous oxide	10	21	4	1	1	20.5	7.64	17.9
Lidocaine supplement to thiopental and nitrous oxide	10	20	1	0	4	18.3	7.68	14.9

first study, lidocaine was given as a supplement after hypothermia had been established The average temperature listed in the table is higher than 20 C, due to onset of ventricular fibrillation before the lower temperature was reached Differences between the anesthetic agents are indicated by the spontaneous incidence, as well as the over-all incidence, of ventricular fibrillation The difference in the total fibrillations with cyclopropane as compared with the other agent is significant at the 5% level Increased tendency for ventricular fibrillation with cyclopropane is also suggested by the high proportion of this arrhythmia, which was initiated spontaneously Another difference noted in these results is the low incidence of fibrillation when lidocaine was used to supplement the thiopental and nitrous oxide However, it is also apparent that there was a sizeable increase in the number of dogs showing heart failure

In the final series of experiments, carried out at 23 C, ven-

tricular fibrillation was prevented in all the dogs except 1 Failure was markedly reduced when lidocaine was used as a supplement

Determination of Venous Pressure in Operating Room, according to Charles C Wycoff[3] (Columbia Univ), can be used as a tool for investigation and diagnosis Many anes thetic agents depress the myocardium and raise central venous pressure Pronounced elevation in venous pressure also occurs after acute heart failure A fall in venous pressure occurs after hemorrhage and also after hypotension due to vascular dilation These phenomena can be evaluated by the continuous determination of the venous pressure

The normal peripheral venous pressure ranges from 60 to

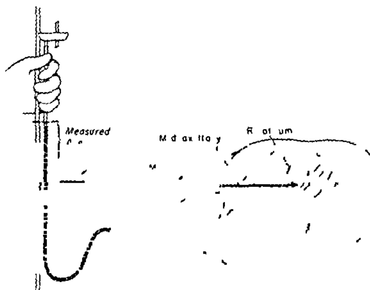


Fig 167.—Determination of venous pressure with intravenous tubing (Courtesy of Wycoff C C New York J Med 59 603-608 Feb 15 1959)

100 mm water Central venous pressure is 20 30 mm water pressure lower Pressure above these levels indicates a pathologic process or an inaccurate determination The elevation of venous pressure that occurs with disease is due to obstruction to the blood flow to or through the right heart The obstruction converts the kinetic energy of the moving blood into potential energy in the dilated veins The pressure that dilates the veins is measured as the venous pressure Several causes of venous pressure elevation are right-sided heart failure, constrictive pericarditis, pericardial effusion with tamponade, thrombosis of the vena cava,

(3) New York J Med 59 603 608 Feb 15 1959

mediastinal tumors, bronchial asthma with obstructive emphysema, local venous obstruction and straining during respiration.

The simplest way to determine venous pressure is to measure the height of the water column in the intravenous tubing when it is disconnected from the bottle of solution (Fig. 167). Rapid fall of the solution and easy fluctuations with respiration indicate there is no obstruction in the vein. An 18-gauge needle is satisfactory for the test. The base line for reference of measurement is the midaxillary line at the 4th intercostal space. This is the approximate position of the right atrium in the supine patient.

A more time-consuming, but more accurate technic of

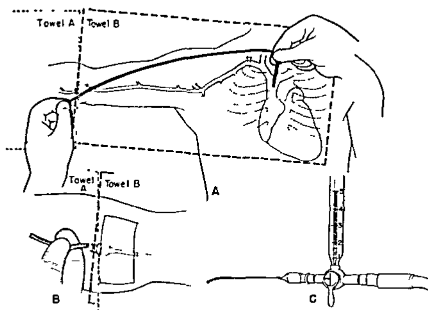


Fig 168.—Determination of venous pressure with catheter in thoracic cavity. *A*, measuring length of catheter to be introduced, *B*, introducing catheter through needle, *C*, reading venous pressure in manometer (leveled to right atrium). (Courtesy of Wycoff, C C.: New York J Med 59 603 608, Feb 15, 1959.)

measurement, is the introduction of a plastic catheter through a 14-gauge needle that has been placed in the lumen of a basilic vein (Fig. 168). This method prevents the possibility of peripheral obstruction due to a poor position of the arm.

► [Venous pressure is often an important clue to significant changes, and it is surprising that this relatively simple observation is not made more often.—Ed.]

Esophageal Cardia and Regurgitation are evaluated by R. N. Sinclair[4] (Victoria Infirm., Glasgow, Scotland). In

(4) Brit. J. Anaesth. 31: 15-21, January, 1959.

the modus operandi of cardiac competence, greatest stress has been laid on the eccentric angle of entry of the esophagus into the stomach and the flap-valve formed at the left lip In addition, there is almost certainly a truly inherent activity at the cardia, which has the physiologic characteristics of a sphincter The diaphragm is not believed to have any part in maintaining cardiac competence, but overaction of the diaphragm can result in incompetence There is no demonstrable anatomic sphincter The pleuroperitoneal pressure differential is a force that constantly tends to favor regurgitation Inspiration against a closed glottis opens the cardia, thus making regurgitation most likely

Gastric retention is aggravated by pain and anxiety, circulatory collapse, salt depletion, morphine, food and drink and reverse peristalsis All these factors must be considered and dealt with the best way possible With regard to premedication, perhaps morphine and similar drugs are best withheld altogether from these patients and atropine alone given Preoperative gastric suction should preferably extend over 1 or 2 hours, continuously or intermittently The one-shot suction effort is hardly adequate

It is quite as logical to block the esophagus to prevent the stomach contents from coming up as to block the trachea to prevent the stomach contents from going down Withdrawal or change in the position of a gastric tube should be avoided while the patient is unconscious because movement of the tube through the esophagus moves the loose mucosa and favors regurgitation A mouthful of water given to the patient to swallow just before induction of anesthesia helps to empty the esophagus, which is a useful safety device Actual induction of anesthesia is probably best carried out on the operating table, with the patient in head up position to obtain the benefit of the effects of gravity

If fluid has entered the air passages, the effectiveness of bronchoscopy as a resuscitative measure may be disappointing and may only increase the spasm Simple suction with a soft rubber catheter through the endotracheal tube may be just as effective and less disturbing

Relative Potency of β β-Methylethylglutarimide (Megimide) and Pentamethylenetetrazol (Metrazol®) was studied by a servo controlled cross over experiment by C Paul Boyan, J Weldon Bellville Kuo Chen Wang and William S

Howland* (Mem'l Center for Cancer, New York) in patients with no known cardiovascular, pulmonary or central nervous system disease who were undergoing minor surgical procedures Drugs used for anesthesia were thiopental, 5% hexylcaine for translaryngeal block and succinylcholine After the patient, anesthesia machine, ventilator, CO_2 analyzer, EEG and servo machine were completely arranged, the patient was maintained in EEG level 2 for a 25-minute control period At the end of this period and every 20-22 minutes thereafter, either megimide or Metrazol® was administered intravenously in a prescribed randomized order Megimide, 75 and 150 mg, was comparable in dose effect to Metrazol®, 100 and 200 mg The amount of thiopental injected per unit time was plotted, the slope of this line was constant during the control period, but it increased after administration of one of the test drugs Then more thiopental was required to maintain a constant level of anesthesia After a time, the effect of the analeptic disappeared, and the slope returned to the original control slope Displacement between control slope and slope after all drug effects have disappeared is a measure of the total thiopental required to compensate for the effect of the analeptic This displacement was expressed in milligrams of thiopental The time in seconds required for the after drug slope to return to the control value was also calculated In terms of their action in reversing the EEG effects of thiopental, megimide was 1 73 times as potent as Metrazol® The 95% confidence limits were 1 3 and 2 6

Mode or site of action of megimide was not ascertained by this study That there was no significant difference in slope of the dose-effect curves suggests the mechanisms of action of megimide and Metrazol® are similar Whether with increasing doses there are increasing responses remains to be determined

► [The method of investigation is intriguing and the results reliable However it still does not resolve the conflict as to the effectiveness of these preparations in the management of barbiturate overdose —Ed]

Evaluation of Traditional Signs and Stages of Anesthesia: EEG and Clinical Study Frequency and time of appear ance of some traditional signs of anesthesia, including respiration, muscular relaxation of the jaws, forearm and abdo men, eyelash reflex, pupillary size and light reflex, ocular

(5) Anesthesiology 19 321 327 May June 1958

movement; and eyelid tone were investigated in relation to the EEG by Stephen J Galla, Angelo G Rocco and Leroy D Vandam[6] (Harvard Med School) in 43 patients (30 males) of various ages, subjected to a variety of anesthetic technics and operations On first analysis, signs of anesthesia seemed confusing and poorly indicative of the anesthetic state It became obvious that uniformity could not be expected in a diversified group of persons Determination of anesthetic depth according to anesthetic signs was a matter of assaying the degree of reflex reactivity

Anesthetic signs in their appearance and disappearance tended to lag behind the EEG level Best signs were those with a definitive reflex response usually elicited by a strong sensory stimulus Respiration, muscle tone and ocular signs, singly and particularly in combination, were valuable indexes of depth of anesthesia In the presence of paralysis produced by muscle relaxants few signs remained to indicate the extent of reflex depression brought about by the general anesthetic

It would seem to be better practice to avoid reference to the traditional anesthetic stages and surgical planes but to speak in terms of minimal reflex depression needed for performance of an operation The impression was gained that signs of anesthesia still provide a sensitive and practical means of assaying depth of anesthesia, even with the use of newer agents and technics Obviously both methods, the EEG and anesthetic signs, have their limitations The EEG is a useful reference in assaying the frequency and time of appearance of anesthetic signs and, consequently, in evaluating their importance

► [Even in these days of polypharmacy and gadgetry, it still seems as though clinical judgment based on sound and critical observations is not outmoded —Ed]

Air Embolism during Intravenous Infusions John W Pickren, Goryun Nigogosyan and James H Kerr[7] (Roswell Park Mem'l Inst , Buffalo) found only one report since 1940 of air embolism occurring without positive pressure In this patient the air entered the tubing through a leak at its attachment to the air chamber

The authors observed fatal air embolism in a patient with terminal lung cancer In this patient practically all intrave-

(6) Anesthesiology 19 328 338 May June 1958
(7) New York J Med 59 493-495, Feb 1, 1959

nous therapy was given through the apparatus shown in Figure 169. Maladjustments or defects in such an arrangement may give rise to air embolism. Kerr demonstrated that the following maladjustment may result in air embolism: when one of the bottles is empty and the clamp on its tube incompletely occludes the lumen, air may be drawn into the

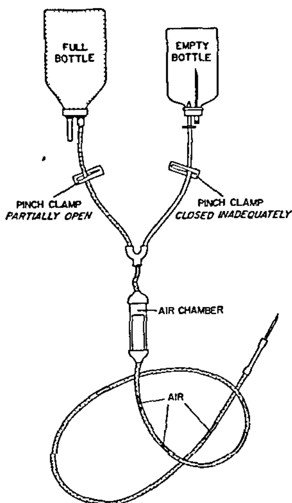


FIG 169 —Y type infusion set with clamps so arranged may allow air in empty bottle to enter with infused fluid (Courtesy of Pickren, J. W, *et al* New York J Med. 59 493 495, Feb 1, 1959)

system via the empty bottle if the clamp controlling the flow rate is placed between the air chamber and the bottle of fluid being infused (Fig. 169). Defective equipment may result in air embolism if the system is not airtight below the clamp regulating the flow rate. If the defect occurs above the air chamber, the fluid level in the air chamber will disappear. A defect below the air chamber may allow air to enter, even

though the fluid level in the air chamber is maintained. Air may enter even through leakage around the connection to the needle if there is negative pressure in the vein.

In the authors' patient, air probably entered through the empty bottle. Incomplete occlusion of the lumen of the tubing attached to the empty bottle is more likely than a defect in the tubing because the clamp on the apparatus is such that airtightness of the tubing is not easily verified.

To prevent air embolism, the clamp regulating the flow rate must be placed on the tubing as near as possible to the vein, i.e., within 3 in. of the needle. The clamps used to select the bottle of fluid to be infused must allow only complete closure or complete opening of the tubing. A hemostat is satisfactory. The vein in which the needle is inserted must be below the level of the heart while the fluid is being infused. The patient's arm therefore must be secured so that the patient may not alter its position to a higher level, thereby allowing a negative pressure in the vein.

Though air embolism under certain circumstances may occur in any type of defective infusion set, an additional factor of maladjustment may allow air to enter through a Y type set, even though no defect is present.

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